Department of the Army

Program Manager for

Chemical Demilitarization

Aberdeen Proving Ground, Maryland

Chemical Stockpile Disposal Program

Programmatic Process Functional Analysis Workbook (FAWB)

Book 23 - Mine Handling System

MHS

Revision 0

September 17, 2002

NOTE: The MHS programmatic process FAWB applies to ANCDF, PBCDF, TOCDF and UMCDF.

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0	NA	Initial Issue

SECTION 1
INTRODUCTION

1.1 CSD PROJECT BASELINE TECHNOLOGY OVERVIEW

The Office of the Project Manager for Chemical Stockpile Disposal (PMCSD) is responsible for the disposal of the United States' existing unitary chemical weapon stockpile. PMCSD manages execution of the design, construction, equipment acquisition/installation, systemization, plant operations, and closure of all CSD project sites.

The CSD project baseline technology consists of the following:

- mechanical disassembly or puncturing the munitions to remove chemical agent and any explosives or propellant,
- incineration of the chemical agent and any explosives and propellant, and
- thermal detoxification of metal parts and any contaminated dunnage.

This technology was demonstrated during a series of operational verification testing (OVT) campaigns at the Johnston Atoll Chemical Agent Disposal System (JACADS). JACADS represented the first generation of a full-scale facility implementation of the project baseline technology. JACADS completed disposal of the chemical agent and munitions stockpiled at Johnston Atoll in November, 2000.

The second generation plants implementing the baseline technology include the following:

- Tooele Chemical Agent Disposal Facility (TOCDF), located at the Deseret Chemical Depot in Tooele, Utah;
- Anniston Chemical Agent Disposal Facility (ANCDF), located at the Anniston Army Depot near Anniston, Alabama;
- Umatilla Chemical Agent Disposal Facility (UMCDF), located at the Umatilla Chemical Depot near Hermiston, Oregon; and,
- Pine Bluff Chemical Agent Disposal Facility (PBCDF), located at the Pine Bluff Arsenal near Pine Bluff, Arkansas.

Unless otherwise noted, the programmatic functional analysis workbooks (FAWBs) for process systems apply to each of these CSD sites.

1.2 BACKGROUND

FAWBs for 25 plant systems were issued for JACADS in January 1985 by The Ralph M. Parsons Company (now the Parsons Infrastructure & Technology Group, Inc.). Parsons is the Design and Systems Integration Contractor (DSIC) for the CSD project. The FAWBs provided the basis for the facility control system's programmable logic

controller (PLC) and computer systems programming. The JACADS FAWBs were later revised by United Engineers & Constructors and, by the July 1989 issue, two additional systems had been added.

FAWBs for TOCDF were issued in April 1993 by Parsons. There were 28 plant systems defined for TOCDF; however, only 27 FAWBs were issued (The Residue Handling Area FAWB was not issued). Most of the TOCDF plant systems were the same as those for JACADS; however, there were some differences due to different plant configurations, system consolidations, and the inclusion of additional systems. The TOCDF systems contractor (SC) received the FAWBs and assumed responsibility for maintaining the set current with the TOCDF plant configuration and the evolution of its operational strategy. Utility system FAWBs also were developed for ANCDF, PBCDF and UMCDF. Their purpose is to assist the sites during utility systems equipment procurement, and to describe their use in facility operation. Utility system FAWBs are more site-specific, consist primarily of SC-procured equipment, and will be maintained by the individual demilitarization sites.

In September 1997, PMCSD began the development of programmatic process FAWBs for process systems common to all sites, eliminating the need to maintain separate process FAWBs at each site. Having a single set of process FAWBs provides a means to ensure operational consistency between the sites and to accurately record differences between the demil facilities. The programmatic process FAWBs serve as an invaluable training tool for the Systems Contractor for Training (SCT) to ensure consistent training on process systems for all sites, and to quickly identify site-specific training requirements.

1.3 PROGRAMMATIC PROCESS FAWB SYSTEMS

Sixteen process systems having minimal differences between sites were designated as programmatic systems. These programmatic process FAWBs are maintained as a single reference rather than at each site. Minor site configuration differences between the sites are highlighted in the FAWB discussions and tables. Fourteen of these 16 systems were included in the 28 original plant system FAWBs developed by the DSIC. For conciseness, the dunnage incinerator (DUN) and DUN pollution abatement system (PAS) FAWBs were to be combined into a single FAWB, for a total of 15 programmatic process FAWBs. However, development of a programmatic FAWB for the DUN and DUN PAS was suspended indefinitely at the direction of the PMCSD Operations Team (see FAWB Note B-1). In addition, FAWBs for the wet PAS and the PAS filter system (PFS) were combined into a single FAWB (see FAWB Note B-2). Therefore, a total of 13 programmatic FAWBs were developed for the process systems. The heating, ventilating, and air-conditioning (HVAC) FAWB originally was included as one of the utility system FAWBs produced for ANCDF in 1996 (HVAC FAWB was Book 9 for ANCDF Utility FAWBs). It has been recategorized as a process system and is included in the set of programmatic process FAWBs.

The programmatic process FAWBs are numbered in accordance with the convention established during production of the ANCDF and UMCDF utility system FAWBs. This convention reserves book numbers 1 through 19 for utility systems, and book numbers 20 through 34 for the process FAWBs. Programmatic process FAWB book numbers and

titles are listed in Table 1.1. The original TOCDF FAWB chapter numbers are shown for reference.

Twelve of the 28 original plant system FAWBs are designated as site-specific utility systems. For these systems, the SC is delivered an initial utility FAWB indicating the system design configuration and operational strategy. The SC maintains the utility FAWBs to reflect the site-specific configuration. The utility FAWBs are listed in Table 1.2; original TOCDF FAWB chapter numbers are shown for reference.

The two remaining systems of the 28 originally planned plant system FAWBs are the acid and caustic storage and wash system (ACSWS) (5.20) and the residue handling area (5.24). The ACSWS FAWB at TOCDF no longer is maintained and has not been developed for follow-on sites (see FAWB Note B-3). A FAWB for the residue handling area was not produced due to its lack of automatic control features.

Table 1.1 Programmatic Process FAWBs

FAWB Book #	FAWB Title (TOCDF FAWB Chapter #)
20	Munitions Demilitarization Building HVAC (5.13)
21	Rocket Handling System (5.1)
22	Projectile Handling System (5.2)
23	Mine Handling System (5.3)
24	Bulk Container Handling System (5.4)
25	Deactivation Furnace System (DFS) (5.5)
26	Liquid Incinerator (LIC) System (5.6)
27	Metal Parts Furnace (MPF) System (5.7)
28[1]	DFS, LIC, and MPF Pollution Abatement System and PAS Filter System (5.9)
29	Brine Reduction Area (BRA) and BRA PAS (5.23)
30	Container Handling Building (5.11)
31	Automatic Continuous Air Monitoring System (5.25)
32	Treaty Compliance Equipment (Not included in original FAWB)
33[2]	DUN System and DUN PAS (5.8 & 5.10)

[1] Per discussions held during the comment resolution matrix meeting for the PAS FAWB on 11-10-98, the draft programmatic process FAWBs for the PAS and PFS were combined into a single PAS/PFS FAWB, Book 28 (See FAWB Note B-2).

[2] As directed at the FAWB teleconference on 9-10-98, a programmatic process FAWB for the DUN/DUN PAS is not being developed (See FAWB Note B-1).

Table 1.2 Site-Specific Utility FAWBs

FAWB Book #	FAWB Title (TOCDF FAWB Chapter #)
1	Fuel Gas System (5.15)
2	Hydraulic Power Unit and Distribution System (5.14)
3	Bulk Chemical Storage System (5.19)
4	Compressed Air Systems (5.16)
5	Steam Generation System (5.22)
6	Door Monitoring System (5.26)
7	Primary Cooling System (5.28)
8	Electrical Distribution & Emergency Power System (5.12)
9	Not used; formerly HVAC
10	Water Systems (5.17)
11	Central Decon Supply System (5.21)
12	Toxic Storage and Handling Systems (5.18)
13	Not used; formerly acid and caustic storage and wash system
14	Fire Detection and Protection System (5.27)
15 - 19	Not assigned; reserved for future use

1.4 PROGRAMMATIC PROCESS FAWB PURPOSE

The programmatic process FAWBs serve as a repository for all control information for the automated aspects of the baseline technology demilitarization process systems. They serve as one of the source documents for PLC control system and computer system programming, operator training, and facility operation. These FAWBs also serve as programmatic reference documents that define how the process systems operate and capture the differences between facility operational configurations. Each programmatic process FAWB contains a subsection that defines the system boundaries and identifies the interfaces with other plant process and utility systems.

Programmatic process FAWBs are living documents, subject to configuration control under the CSD project Participant Quality Assurance Plan. They are meant to be continuously updated with user input whenever system modifications are made, or as needed to enhance the information presented. Programmatic process FAWB revisions are implemented as outlined in Section 1.6. The process by which the SCT maintains the programmatic process FAWBs and the roles and responsibilities of each organization affiliated with the CSD project are described in detail in the Programmatic Process FAWB Maintenance Plan.

Programmatic Process FAWB Limitations

Even though the FAWBs contain detailed descriptions of the configuration and control for each process system, they are not all-inclusive. Every effort is made to include the

level of detail necessary to fully describe the specific operating configuration for each process system. Each process FAWB includes supporting references to direct the user to relevant programmatic and site-specific documentation (e.g., standing operating procedures, drawings).

Because of the revision cycle time, there will be a slight lag time between recent changes and their reflection in the FAWB. Maintenance of the FAWBs will be done semiannually, or more frequently if needed, to reflect significant modifications.

The FAWB maintenance program relies heavily on input from each baseline technology demilitarization site. Timely and accurate input ensures that the FAWBs reflect the current configuration at each of the sites. All information received will be thoroughly reviewed to ensure consistent and accurate documentation.

As a programmatic document, the FAWBs describe the configuration and operation of four separate facilities. Care must be taken by the user to ensure that the information extracted from this document reflects the configuration for the facility of interest. Site-specific differences are highlighted in both the text and the appendices to avoid confusion.

1.5 PROGRAMMATIC PROCESS FAWB ORGANIZATION

The process FAWBs document the chemical demilitarization facility operations at ANCDF, PBCDF, TOCDF, and UMCDF. The format and structure of the programmatic process FAWBs differ from the original format prepared by the DSIC, and from the format previously maintained at TOCDF. The information from earlier versions has been retained and updated to reflect lessons learned from the design, construction, systemization, and operation of the demilitarization facilities, including JACADS and the Chemical Agent Munition Disposal System (CAMDS). The overall layout of the programmatic process FAWBs is shown in Table 1-3.

1.6 PROGRAMMATIC PROCESS FAWB REVISIONS

The programmatic process FAWBs are maintained by the SCT to reflect the operational and control system configuration at each CSD site that implements the baseline destruction technology. Each programmatic process FAWB will be reviewed and revised, as required, on a semiannual basis. Individual process FAWBs can be revised more frequently, if needed, to reflect significant configuration changes. Programmatic process FAWB modifications can be generated by the following:

- Engineering change proposals at any of the CSD sites
- CSD project programmatic lessons learned
- Operational modifications that do not involve configuration changes
- Programmatic changes
- Need for greater detail or clarification

The programmatic process FAWB maintenance plan identifies the organizations that participate in the FAWB maintenance program and the responsibilities of each to supply information that could result in revisions to the FAWB. All organizations are represented

on the FAWB Evolvement/Evaluation Team (FEET), and are involved with review of each FAWB revision to ensure that the site configuration and operating strategy is current.

Table 1.3 Organization of the Programmatic Process FAWBs

Section	Title	Contents
1	Introduction	General FAWB background, organization, and revision method
2	System Overview	Purpose of the system; operational and process design basis summary; system boundaries and interfaces
3	Process Description	Description of subsystems; control sequences
4	Component Summary	Tables listing parameters for primary components; power source listings
App. A	Acronyms and Abbreviations	
App. B	FAWB Notes	Notes that provide additional detail or background information
App. C	Alarm and Interlock Matrices	Programmatic matrices or matrices for each site
App. D	PLC Automatic Control Sequences	Automatic logic contained in the PLC code; burner management system automatic controls; sequencer logic for demil systems
App. E	Operator Screens	Advisor PC screens for each site
App. F	Instrument Ranges	Tables showing instrument ranges and setpoints
App. G	Intercontroller Communications	Tables listing the digital intercontroller inputs/outputs (DICIs/DICOs)
App. H	References	Listing of reference documents, including drawings, used to prepare and maintain the FAWB

SECTION 2
SYSTEM OVERVIEW

2.1 PURPOSE AND FUNCTION

The mine handling system (MHS) is used to remove M23 land mines from their storage containers (mine drums), drain agent from the mines, access the central burster, and deliver the agent and mine components to the appropriate furnace systems for incineration and thermal detoxification. The MHS is composed of two subsystems: mine handling in the unpack area (UPA) and mine processing by the mine machine (MIN). In the UPA, operators manually unpack mines from the shipping drum, and load the mines onto conveyors for delivery to the MIN. Mines are conveyed from the UPA through the explosive containment vestibule (ECV), and into an explosive containment room (ECR) where the MIN is located. In the ECR, mines are demilitarized by removing the agent stored in the mine body cavity, and removing the bottom fuzewell adapter plate to allow the central burster to fall out of the mine body. Mines and components are delivered to the deactivation furnace system (DFS) for destruction. Drained agent is collected in the agent quantification system (AQS) in the ECR before being transferred to the agent collection tank in the toxic cubicle (TOX). Agent is stored in the TOX until conditions are established for incineration in the liquid incinerator (LIC) system.

2.2 OPERATIONAL SUMMARY

The MHS is used for processing VX-filled M23 land mines, shown in Figure 2-1, found in the United States' unitary chemical weapons stockpile. Mines are processed in the munitions demilitarization building (MDB) on a single processing line. The following sections describe the mine handling process based on the JACADS configuration, with revisions based on enhancements being developed at the CDTF and site-specific modifications being identified for TOCDF implementation. Design documentation does not reflect the described components and configuration, but will be revised to show the actual equipment and process as they are implemented.

2.2.1 Mine Preprocessing

Palletized drums of mines are kept offsite in storage igloos. Each pallet in its storage configuration consists of 12 mine drums; each drum contains three mines, as shown in Figure 2-2. At JACADS, mines drums were repalletized to consist of only 6 drums in a single layer to facilitate pallet handling in the MDB. TOCDF is repalletizing mines similar to JACADS. All other sites have yet to determine whether or not they will repalletize mine drums (see FAWB Note B-4).

A single pallet of six or twelve mine drums is loaded into an on-site container (ONC) at TOCDF, or enhanced ONC (EONC) at other sites, before being trucked to the container handling building (CHB) at the site (see FAWB Note B-4). In the CHB UPA (first floor UPA at PBCDF), ONCs/EONCs are monitored for leaking mines/mine drums before being unloaded. If agent is not detected in an ONC/EONC, the pallet of mine drums is

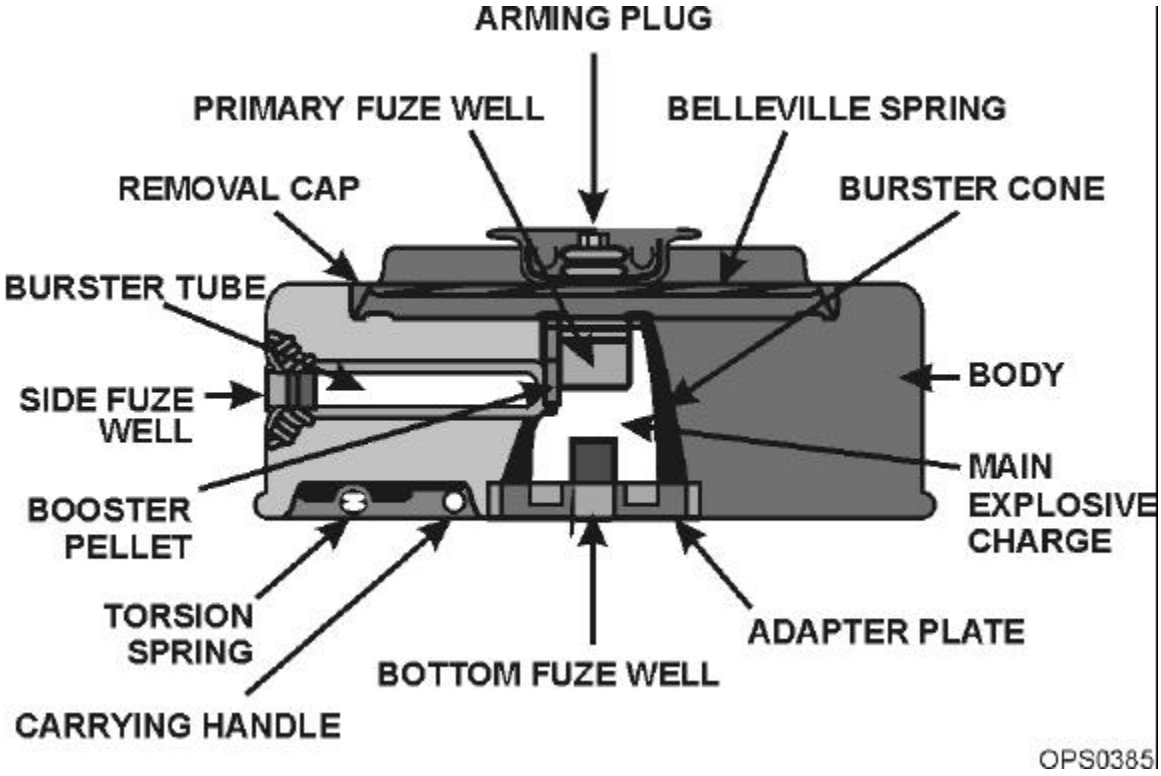

Figure 2-1. M23 Land Mine

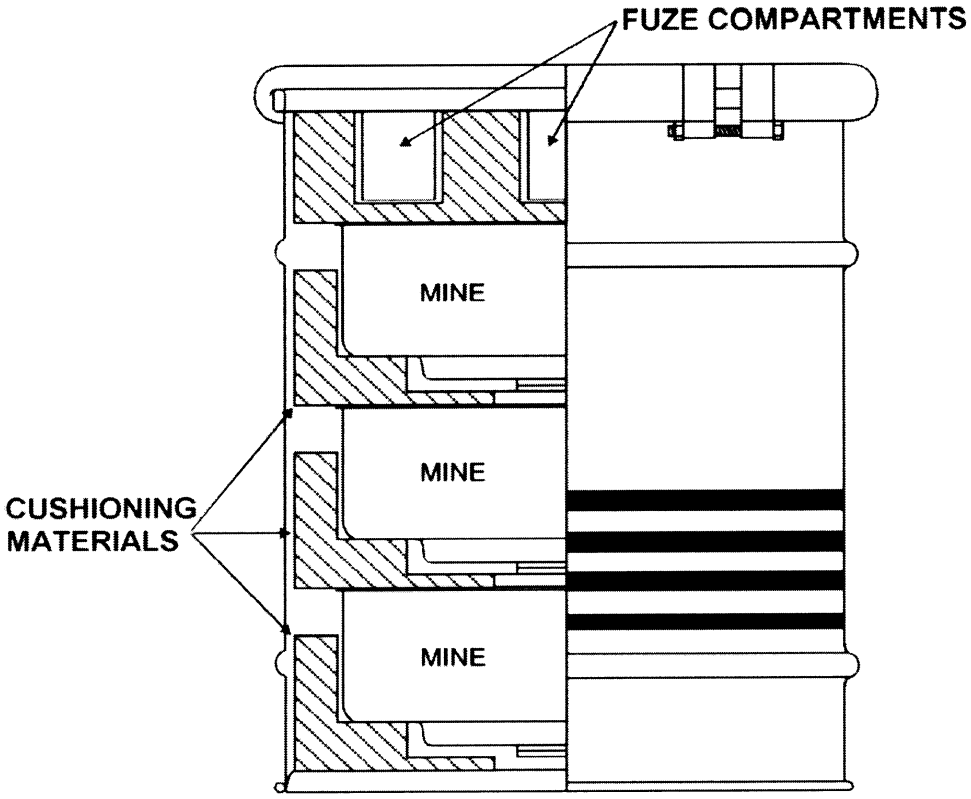

Figure 2-2. M23 Land Mine Packing Drum

removed from the ONC/EONC and delivered to the MDB UPA for unpacking. If agent is detected, ONCs/EONCs are handled according to site-specific procedures.

UPA operators dismantle each pallet and separate the drums. Before processing drum contents, UPA operators remove the drum lid and monitor for agent presence using an ACAMS wand. Because of the potential to encounter agent vapors, UPA operators wear personal protective clothing and equipment (see FAWB Note B-5). Once verified to be free of leaking mines, the drum is designated as OK for unpacking. If agent is detected in the drum, the lid is placed back on; the drum is put on a tray assembly on a bypass line and conveyed into the ECV where workers in demilitarization protective ensemble (DPE) can unpack it.

2.2.2 Mine UPA Processing

After switching to a reduced level of protective clothing and equipment to facilitate unpacking (see FAWB Note B-6), UPA operators remove the fuzes and activators from the top layer of packing material and place them into a mine component container (MCC). MCCs are cardboard containers shaped similar to a mine with six spaces to hold all the fuzes and activators from a single mine drum (see FAWB Note B-7). Once the MCC is filled, UPA operators put on a lid and place the MCC on an accumulation conveyor or, at TOCDF, on the rocket/mine input conveyor no.1 (MMS-CNVM-102).

UPA operators continue unpacking mine drums manually by removing spacing materials[1] and removing mines using a mine lifting assembly. Mines are lifted out of the drum upside down and placed onto a conveyor section with unpowered rollers. After detaching the mine lifting assembly, a UPA operator manually turns the mine over and slides it onto a powered conveyor section. Mines are automatically transferred from the UPA through an airlock onto rocket/mine input conveyor 2 (MMS-CNVM-103/104) in the ECV[2].

TOCDF plans to use a single feed conveyor in the UPA. JACADS used an accumulation conveyor system capable of storing 100 metal mines and 25 MCCs (see section 3.3.1.2). ANCDF, PBCDF, and UMCDF sites may use similar systems or develop their own based on UPA space availability and throughput requirements.

2.2.3 Mine ECV/ECR Processing

Mines/MCCs travel through the ECV on rocket/mine input conveyor 2. In the ECV, mines/MCCs go through a metering assembly that is an integral part of rocket/mine input conveyor 2. The metering assembly consists of two stops that cycle to allow only one mine/MCC at a time to be sent to the ECR (see FAWB Note B-8, B-23 and B-24).

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[1] At JACADS, if ACAMS sampling of the mine drums did not detect the presence of agent, the drums and packing material were disposed of as nonhazardous waste. CONUS sites will develop their own procedures for handling and disposal of this waste (see FAWB Note B-1).

[2] The design specifies the MIN to be installed in ECR A. TOCDF found that because of equipment configurations, campaign changeover times, and scheduling, it would be more efficient to install the MIN in ECR B. The ANCDF, PBCDF, and UMCDF systems contractors will determine which ECR they use for mine processing. Equipment tags numbers for both lines are included in the FAWB.

Mines/MCCs enter the ECR through the munition access blast gate and are received by the MIN input conveyor. Integral to the MIN input conveyor is a set of metering pins that hold mines/MCCs at the MCC verification station, where a mechanical probe and an inductive proximity sensor determine whether the item is a mine or an MCC. Mines/MCCs are metered one at a time from the MCC verification station to the yoke assembly. While held in the yoke assembly, mines are oriented, and punched and drained. If the item is an MCC, the yoke rotates 180° to bypass the orientation and punching/draining operations and place the MCC upside-down on a trolley. If a mine is in the yoke assembly, the orientation table rotates the mine and positions it in the yoke so that when the mine is punched, the punch does not strike the side well burster. After being oriented correctly, the yoke assembly is rotated 90° (mine is held vertically) to the punch and drain station (PDS). While the mine is vertical, a punch is extended through the side of the mine. The punch also serves as the drain tube through which agent is drained. After agent is drained from the mine, the punch retracts, and the yoke assembly rotates another 90° to place the mine upside-down on the trolley.

The trolley transports the mine/MCC to the fuzewell adapter removal station (FARS[3]), where a disc and pin assembly extends to engage and unscrew the adapter plate from the bottom of the mine. After the adapter plate has been unscrewed, the disc and pin assembly remains extended while the trolley is withdrawn. The mine/MCC remains at the FARS and drops onto the trolley tracks. The disc and pin assembly then retracts and the trolley is driven forward again to push the mine/MCC off of the tracks and onto to the DFS slide gate, MMS-GATE-101/102.

2.3 PROCESS DESIGN BASIS SUMMARY

The MHS is designed to perform the initial stages of demilitarization processing for M23 land mines. The MHS drains agent from mines for collection and subsequent delivery to a LIC, accesses the central burster to facilitate burning in the DFS, and feeds fuzes, activators, and drained mines to the DFS.

Design documentation shows the use of the MIG for mine drum unpacking in the UPA, and also includes a burster punch station (BPS) in the ECR. JACADS processed mines without using the MIG and BPS. Instead of using the MIG, UPA operators unpacked mine drums and placed the mines on an accumulation conveyor system, which conveyed the mines into the ECV through a mine airlock. TOCDF plans to use a single feed conveyor in the UPA.

The BPS was replaced with the FARS (see FAWB Note B-9). PMCD has approved the use of equipment similar to the JACADS configuration for mine handling and processing at CONUS sites.

There is only one mine processing line, which was designed to process 82 mines per hour. During operation, the MIN can process three mines simultaneously; one at the MCC verification station, one at the PDS and one at the FARS.

Mines are demilitarized in an ECR, which is designed to withstand the explosive force of 15 lb of TNT (in units of equivalent explosive weight). Normal operations allow up to 7

[3] Also referred to as fuzewell assembly removal station.

mines to be in the ECR at any given time. With less than 1 lb TNT equivalent in each mine, the total explosive material in the ECR during normal operations is well below the ECR explosive material limit.

2.4 SYSTEM BOUNDARIES AND INTERFACES

The MHS system includes equipment that extends from the mine accumulation conveyors, or rocket/mine input conveyor no.1 at TOCDF, in the UPA, through the ECV and into the ECR. The MHS has a direct interface with the DFS[4]. Mine draining operations are coordinated with the TOX system. Several plant systems are required to supply the utilities and power required by the various operations, machines, and conveyors. The ECR personnel access blast doors and blast gates will be interlocked with process operations. The primary interfaces include the following:

(1) UPA: Feed to the MHS comes from the UPA, where operators load mines and MCCs onto a conveyor.

(2) Toxic Storage and Handling: Agent drained by the punch and drain station in the ECR is pumped to agent collection tanks in the toxic storage and handling system.

(3) DFS: Drained mines, fuzes, and activators are fed to the DFS through the feed chute in the ECR.

(4) MPF: The design specifies collection of empty mine drums in mine drum baskets for delivery to the MPF for thermal processing (see section 3.3.4).

(5) Utilities: The MHS requires electric power, hydraulic power, and plant air for operation of the processing and handling equipment. Process water/decon can also be supplied when needed for DFS gate cooling spray.

[4] There is no interface listed for the dunnage furnace system. Final disposition of dunnage generated from mine unpacking operations has not yet been determined (see FAWB Note B-1).

SECTION 3
PROCESS DESCRIPTION

3.1 INTRODUCTION

The mine handling system (MHS) is designed to process both non-leaking and leaking mines, as well as mine component containers (MCCs). Mine drums are unpacked in the UPA and mines are placed on a feed conveyor or an accumulation conveyor system. Mine processing is accomplished in an ECR where mines are punched and drained to remove agent, and the central burster is accessed to facilitate burning in the DFS. There is only a single line for mine processing.

Design documentation shows the use of a mine glovebox (MIG) for unpacking of mine drums in the UPA, and also includes a burster punch station (BPS) in the ECR. JACADS processed mines without using the MIG and BPS. Instead of using the MIG, UPA operators unpacked mine drums and placed the mines on an accumulation conveyor system, which conveyed the mines into the ECV through a mine airlock. TOCDF plans to use a single feed conveyor in the UPA.

The BPS was replaced with the fuzewell adapter removal station (FARS[1]) (see FAWB Note B-9). PMCD has approved the use of equipment similar to the JACADS configuration for mine handling and processing at CONUS sites. The following sections describe mine handling and processing equipment based on the JACADS configuration, with revisions based on enhancements being developed at the CDTF and site-specific modifications being identified for TOCDF implementation. Design documentation will be revised to show the actual equipment and process as they are implemented.

3.2 MINE PROCESSING EQUIPMENT

Mines are processed in an ECR by the mine machine (MIN). The design specifies the MIN to be installed in ECR A. TOCDF found that because of equipment configurations, campaign changeover times, and scheduling, it would be more efficient to install the MIN in ECR B. The ANCDF, PBCDF, and UMCDF systems contractors will determine which ECR they use for mine processing.

A maximum of three mines can be processed by the MIN at any one time: one mine is at the MCC verification station, another is punched and drained at the punch and drain station (PDS) while the other has the fuzewell adapter plate removed at the FARS. The drained agent is measured and sent to the toxic storage area (TOX). Mines are dropped onto the RSM/BSR & MIN discharge blast gate (MMS-GATE-103/104) that feeds the DFS.

[1] Also referred to as fuzewell assembly removal station.

Safety concerns prohibit the punching of mines or removal of the fuzewell adapter plate while any munitions access blast gate, DFS feed gate, or personnel access blast door is open (defined as not closed) in the ECR when using the MIN. When either the PDS punch or the FARS cylinder is not retracted the doors and gates will be interlocked closed. The door and gate position switches are wired into the MHS controller and are displayed on the process control screen. The various gates in the ECR can be controlled from the MHS control screens.

The munitions access and discharge blast gates used for projectiles are not required in the mine campaign. These gates remain closed throughout the mine campaign. Opening of a projectile access blast gate will stop the MIN. The gates must be closed and the closed position switches active or the gates must be locked closed and the position switch active before starting the mine campaign.

3.2.1 Mine Machine

The MIN, MHS-MIN-101, is designed to punch and drain the agent from M23 mines and then remove the fuzewell adapter plate allowing the central explosive charge (M38 conical burster) to fall out of the mine to facilitate burning in the DFS. The design destruction capacity of the MIN in its original configuration was 82 mines per hour; however, actual destruction rates at JACADS were lower. JACADS was limited by their RCRA permit to 70 mines per hour feed to the DFS. CONUS sites have similar permit limits. JACADS was further limited by the addition of the FARS and a number of machine performance issues that are described in the following sections. The maximum machine throughput achieved at JACADS was 46 mines per hour.

The MIN is located in an ECR and is separated from the ECV by blast gates. The MIN consists of five stations: 1) the MCC verification station, 2) the orientation station (OS), 3) the PDS, 4) the trolley transfer station, and 5) the FARS. Two sequencers control MIN operations: the PDS sequencer controls operations at the OS and PDS, and the FARS sequencer controls the trolley and FARS operations. The MCC verification station is a recent addition and its operation is relatively simple, so it is not planned to have its operation controlled by a sequencer.

3.2.1.1 MCC Verification Station

The MCC verification station determines whether the item on the conveyor is a mine or an MCC. The station consists of a set of metering pins, a mechanical probe designed to differentiate between MCCs and mines, and an inductive proximity sensor, PLS-1.

In the original design, PLS-1 was located at the OS to examine the item in the yoke assembly. At JACADS, PLS-1 would sometimes indicate that an MCC was a metal mine. The proximity sensor was apparently seeing a fuze in the MCC. JACADS added a redundant proximity sensor on the other side of the conveyor and required both sensors to be in agreement for the item to proceed.

For CONUS sites, the MCC verification station has been added as a new processing step. A mechanical probe has been added as an alternative to another proximity sensor and PLS-1 was moved from the OS. The mechanical system allows for a redundant check using a differential type of sensor, thus eliminating the potential for common-cause failures that could cause both proximity sensors to indicate incorrectly. PLS-1 was

relocated so that both detectors can examine the item at the same location. If PLS-1 does not agree with the mechanical probe, processing will be interrupted until an operator verifies whether an MCC or a metal mine is present and ensures the proper processing sequence is performed.

The mechanical probe differentiates between MCCs and metal mines by inserting a probe through the center of the item on the conveyor as it is held in place by a set of stop pins that meter mines to the OS (see section 3.3.3). MCCs have a hole completely through them whereas metal mines have an arming plug in place that prevents the probe from extending. Even if the arming plug is missing, the probe is prevented from extending through a mine by the booster pellet and central burster. The rubber tipped probe operates on low pressure air (~10 psig) to minimize impact on the mine when extended. If the probe extends completely, the item is identified as an MCC. If the probe does not extend, it is identified as a metal mine. PLS-1 is used to confirm the identity of the item.

After the MCC verification system successfully identifies the item as a mine or an MCC, the set of stop pins lower to advance the mine/MCC to the OS when the PDS sequencer is requesting a mine. The stop pins raise again when a mine/MCC is no longer detected at the stop pins.

3.2.1.2 Orientation Station

The OS receives mines/MCCs as they are indexed from the MCC verification station. It consists of a yoke assembly, lift table, orientation cylinder, orientation motor and 2 sensors[2]. The primary function of the OS is to orient the mine correctly for processing at the PDS.

Mines/MCCs are metered one at a time and fed into the yoke at the OS. The yoke is a moveable steel frame attached to the shaft of the hydraulically operated yoke rotary actuator (see FAWB Note B-10). The yoke is shaped to accommodate the mine in its upright position. The yoke holds the mine in place as it is oriented at the OS, during transit and processing at the PDS, and to the trolley discharge point. The 180° movement of the yoke is controlled by the yoke rotary actuator.

An infrared, fiber-optic, transmitter-receiver, proximity sensor (PLS-12) verifies the presence of the object in the yoke. The processing sequence is different depending on whether the object in the yoke is a metal mine or an MCC, as determined by the MCC verification station. If an MCC is in the yoke, the yoke is rotated 180° by the yoke rotary actuator. The MCC bypasses the PDS and is transferred directly to the trolley.

If a mine is in the yoke, the orientation cylinder retracts which raises the lift table. The orientation motor starts to rotate the mine allowing spring-loaded pins to engage the adapter plate. A spring-loaded wheel with a latch rides on the bottom of the mine and extends into the recessed area of the mine's handle, activating the handle-oriented fixed-

[2] The original OS design had two additional sensors, PLS-1 and PLS-3. PLS-1 was moved to the MCC verification station (see section 3.2.1.1). PLS-3, the burster-well-oriented sensor, was a fixed-focal-length photoelectric switch. PLS-3 projected a light beam that would reflect off the stainless steel burster well. The reflection would be detected by the receiver part of the sensor. Because of reliability problems, this sensor was eliminated (see FAWB Note B-11).

focal-point proximity sensor (PLS-2). The orientation motor stops after PLS-2 indicates that the mine is oriented properly (see FAWB Note B-11). A short time delay (< 0.5 sec) is used to ensure that the spring-loaded wheel is in the mine-handle recessed area rather than in a dent in the bottom of the mine. The orientation cylinder then extends to lower the lift table. If PLS-2 is not made within 5 seconds, a malfunction alarm is sounded in the CON and the MIN stops.

3.2.1.3 Punch and Drain Station

The PDS receives correctly oriented mines in the yoke, inserts the agent drain punch into the mine, and drains the liquid chemical agent from the mine. If an MCC is in the yoke, the yoke simply rotates past the PDS. The PDS uses a yoke stop, a drain clamp, and a drain punch to perform its actions.

After a mine is properly orientated and the lift table is lowered, the yoke stop cylinder is retracted, moving the yoke stop out to stop the yoke in the vertical position when it is rotated. The yoke rotary actuator is rotated until the yoke contacts the yoke stop, which holds the yoke in the vertical position (i.e., yoke rotates 90° and is held perpendicular to the conveyor line). The mine is now ready to be punched, and is oriented with the side-well burster clear of the punch path.

Sensor PLS-5 detects the yoke at the drain position. The drain clamp hydraulic cylinder extends and positions the drain clamp, which holds the mine securely in position for punching. The drain punch hydraulic cylinder extends and positions the drain punch, which punctures the side of the mine. The drain punch hydraulic cylinder rod is hollow on the inside and serves as the drain tube for the agent. The drain punch extends to the lowest part of the agent reservoir and agent transfer pump ACS-PUMP-107 drains the agent to the AQS tank. The AQS is described in section 3.2.1.7. The drain punch remains extended for approximately 20 seconds to drain the mine. If the quantity of agent drained is greater than or equal to 95 percent of the expected agent charge in the mine (see FAWB Note B-12), the mine can be released from the PDS.

If less than 95 percent of the expected agent is drained, an INSUFFICIENT AGENT DRAINED alarm sounds and processing stops. The CRO can use either the REPEAT function to repeat the drain sequence or the BYPASS function to allow processing to continue with a mine that is not completely drained. The decision to repeat or bypass the drain sequence is based on two items: (1) the amount of agent drained from the mine, and (2) the amount of agent currently being processed in the DFS, which is calculated from the agent heel left in the previously processed mines.

A mine that does not drain sufficiently can not be fed to the DFS if its agent heel causes the DFS to exceed the allowable hourly feed rate. When the agent heel in the mine no longer exceeds the allowable feed rate, the mine can be fed to the DFS. DFS allowable hourly feed rates are discussed in the DFS FAWB (Programmatic Process FAWB Book 25).

After the mine is drained, the drain punch cylinder and the drain clamp cylinder are retracted. The yoke rotary actuator is deenergized while the yoke stop cylinder is extended, which pulls the yoke stop in to allow the yoke to be rotated further. The yoke rotary actuator is reenergized to rotate the yoke another 90° so the mine is placed upside

down on the trolley. Sensor PLS-6 detects the yoke at the discharge position on the trolley.

At this point the process is identical for mines and MCCs. The trolley moves the mine/MCC out of the yoke towards the FARS. The yoke moves back to the home position once sensor PLS-11 indicates that the mine/MCC is clear of the yoke. The yoke is now ready to accept another mine/MCC.

At JACADS, a liquid catch pan was fabricated and installed on the MIN directly below the drain tube at the punch and drain station to catch any liquid dripping from the drain tube. A hose from the collection pan routed liquids onto the pan mounted under the yoke rotary actuator and trolley (see section 3.2.1.4). A similar catch pan and hose will be used at CONUS sites.

3.2.1.4 Trolley Transfer Station

The trolley removes mines/MCCs from the yoke assembly and transfers them to the FARS. The original design includes a trolley with four wheels that runs on a two-railed track. At JACADS, failure of the trolley transfer station was the most significant cause of downtime for the MIN. The primary cause of trolley failures was the trolley coming off the tracks. Demilitarization protective ensemble (DPE) entries into the ECR were required to place the trolley back on its track before processing could resume. The next greatest contributor to trolley station downtime was MCCs getting stuck at the trolley on the way to the FARS. A DPE entry was required to clear the MCCs off the trolley tracks.

A new trolley has been developed at the CDTF that is driven by pneumatically operated rodless cylinders that move carriages on sealed tracks. The new trolley cannot jump off its tracks, thereby eliminating the primary downtime contributor at the FARS. The concern with MCCs getting stuck was addressed by redesign of the MCC (see FAWB Note B-7).

To facilitate maintenance and ECR cleanup, JACADS added a stainless steel chute under the travel path of the trolley. The 15-inch wide pan was mounted under the discharge side of the yoke rotary actuator and angled downward through a front opening to the DFS slide gate. The angle of the pan (approximately 45 degrees) provided a good path for any liquid or parts dropped at any point along the trolley to be caught and guided directly onto the DFS gate. The front opening of the DFS slide gate enclosure was modified to allow for chute penetration, while also preventing mines, mine parts, or liquid from bouncing out of the slide gate area. The pan also received any liquids collected in a catch pan under the PDS via a hose onto the pan (see section 3.2.1.3).

3.2.1.5 Fuzewell Adapter Removal Station

The trolley moves forward to position the mine/MCC at the FARS. The FARS consists of a disc and pin assembly with pneumatic cylinder and hydraulic unthread motor, an antirotation bar, a stripper plate, a hold back assembly, and two sensors. The primary function of the FARS is to unscrew the fuzewell adapter plate to allow the central burster to separate from the mine, thus promoting burning rather than explosion of the burster in the DFS. At JACADS, FARS operation was identical whether a mine or an MCC was present. At CONUS sites, the sequencer may be modified to bypass the step to unscrew the adapter plate when an MCC is present (see FAWB Note B-13).

When the trolley reaches the FARS and a mine/MCC is detected by PLS-9, the FARS pneumatic cylinder extends the disc and pin assembly to engage the fuzewell adapter plate[3]. The disc and pin assembly has a center shaft with a tapered end that extends into the center hole in the fuzewell adapter plate to ensure that the centerline of the FARS is aligned with the centerline of the mine. The disc and pin assembly begins to rotate. When the pins are aligned with the holes in the adapter plate, the cylinder drives the pins into the holes and the mine begins to rotate with the pin and disc assembly. The mine turns until the antirotation bar drops into the mine handle recessed area and stops the mine from rotating. The antirotation bar is a pivot arm that drops by gravity onto the bottom of the mine as the mine turns. At the end of the bar is a recessed area that "catches" the mine handle to prevent rotation of the mine. The FARS motor continues rotating for approximately 15 seconds to unscrew the adapter plate.

JACADS occasionally had problems with the motor stalling during fuzewell adapter plate removal. The mine would become physically stuck onto the FARS disc and pin assembly when the motor stalled, which would require a DPE entry to correct. JACADS added a manually initiated two-second reverse cycle pulse action to the FARS motor. This short pulse was sufficient to dislodge a mine stuck between the pins and the antirotation bar. The machine was not originally equipped with a reverse capability, so there were electrical, hydraulic, and programming changes required to add the feature. The reverse-pulse feature will be implemented at CONUS sites.

JACADS also upgraded to a higher torque FARS motor during the campaign, which improved the adapter plate removal capability of the FARS. CONUS sites will have FARS motors with even greater torque than the upgrade at JACADS.

After the adapter plate is unscrewed, the trolley moves in reverse and stops at the mid-position as indicated by PLS-10. The mine is prevented from being carried with the trolley by the holdback assembly that extends with the pin and disc assembly. The mine drops onto the trolley tracks and the disc and pin assembly retracts through a stripper plate to strip off the adapter plate if it happens to remain attached to the disc and pin assembly.

The trolley extends forward to the FARS and pushes the mine off the tracks and onto the RSM/BSR & MIN discharge blast gate, MMS-GATE-103/104 (see FAWB Note B-14).

3.2.1.6 DFS Feed Chute and Gate Assembly

The DFS feed chute and gate assembly is controlled by the DFS controller (Refer to programmatic process FAWB 25 for more information about the operation of the gates and the coordination of the gate operation with the DFS rotary kiln position.)

3.2.1.7 Agent Quantification System

Agent drained from the mine agent cavity is measured by the AQS and the amount drained is recorded by the PLC. The MHS uses the universal AQS which was developed to standardize the AQS at all sites, as well as standardize the AQS for all demil machines

[3] According to munition drawings, fuzewell adapter plates may be made of metal or plastic. At JACADS, all plates were metal.

(see FAWB Note B-15). Tag numbers in the following text reflect those at the CDTF; site tag numbers may be different.

The MHS AQS consists of AQS verification tank ACS-TANK-108, agent transfer pump ACS-PUMP-107, and associated valves, piping and instrumentation. Agent is drained from the mine to the AQS verification tank for quantification, and then transferred to the agent holding tank in the TOX. The agent transfer pump runs continuously when the MHS is in AUTO to ensure a vacuum is drawn in the AQS during the draining sequence. AQS tank vacuum valve 51-XV-759 remains open for most of the sequence to maintain a vacuum in the AQS tank. It closes during quantification of agent, remains closed while the tank is drained, and reopens when the PDS is ready to drain the next mine.

Agent draining operations begin when the AQS tank inlet valve 51-XV-757 opens. The valve remains open for a preset time to ensure the agent is drawn into the AQS tank. When the drain timer expires, the AQS tank vacuum valve closes, and the AQS tank level indicating transmitter 51-LIT-754 is brought online by opening the two AQS tank level sensor isolation valves 51-XV-755A/B. A differential-pressure level detector senses the AQS tank level. The AQS tank inlet valve remains open during verification of agent tank level to ensure that the pressure in the AQS tank headspace is in equilibrium with the ECR room pressure.

If the agent level measured in the AQS tank exceeds twenty-five inches a TANK LEVEL HI alarm is sent to the CON.

The PLC compares the measured agent level in the AQS tank against the nominal fill level for the M23 mine (see FAWB Note B-12). If the agent level measured in the AQS tank is 95% or more of the nominal level, the mine is considered sufficiently drained. The AQS tank drain valve is opened and agent is drawn out of the AQS tank and sent to the TOX. If the agent level in the AQS tank is not zero by the time the AQS tank drain valve has been open for 10 seconds, a TANK NOT DRAINING alarm is sent to the CON. The timer for this alarm starts when the AQS tank drain valve indicates OPEN. When the AQS tank level LIT indicates an agent level less than the minimum required for three seconds, the AQS tank LIT isolation valves close, the AQS tank drain valve closes, and the AQS tank LIT purge valve (51-XV-756) opens for 15 seconds to purge any agent from the sensing line. Purge air is supplied from the instrument air system. Finally, the strainer drain valve and AQS tank drain valve close and the drain cycle is complete.

The AQS tank level sensor's purge valve is interlocked from opening if either of the isolation valves connecting the sensor to the line is OPEN. This is necessary to prevent the higher-pressure purge air from being fed to a delicate instrument.

If the agent level measured in the AQS tank is less than 95% of the nominal level, the CON operator can use the REPEAT function to repeat the drain sequence. The decision to repeat the drain sequence is based on two items: (1) the amount of agent drained from the mine as indicated by the LIT, and (2) the amount of agent currently being processed in the DFS, which is calculated from the agent heel left in the previously processed mines.

The PLC calculates the agent heel remaining in each mine by subtracting the amount drained from the nominal fill value for an M23 mine (see FAWB Note B-12). This amount is added to the total quantity of agent drained for the day (i.e., 24-hour period

running from midnight to midnight). The agent heel, which is fed to the DFS along with the mine, is added to a rolling hourly total of agent fed to the DFS each hour. If feeding the agent heel from any mine would cause the DFS allowable hourly feed rate to be exceeded, the mine is not fed until the PLC calculates that the feed rate limit will not be exceeded. DFS allowable hourly feed rates are discussed in the DFS FAWB (Programmatic Process FAWB Book 25).

3.3 MINE HANDLING EQUIPMENT

Handling equipment for mines prior to processing in the ECR includes tools used by UPA operators to open and remove mines from mine drums, the conveyor(s) in the UPA, the mine airlock (MHS-AIRL-101[4]) which connects between the UPA and ECV, rocket/mine input conveyor 2 (MMS-CNVM-103/104) in the ECV, and associated gates, stops and sensors.

3.3.1 Mine Handling in the UPA

The original design at all sites includes the use of a mine drum feed scissor lift conveyor, MHS-CNVP-101, and the mine glovebox (MIG), MHS-GLBX-101, to remove mines from mine drums and deliver them to the ECV for processing. In addition, the design includes handling of packing materials and mine drums in the MIG. The MIG will not be used to process mines at any of the sites. Instead, the systems described in the following sections will be used. Design drawings will be modified to reflect the revised processing configuration.

3.3.1.1 Mine Drum Preprocessing

ONCs at TOCDF, or EONCs at other sites, are delivered to the container handling building (CHB)[5] unloading docks and, at ANCDF, TOCDF, and UMCDF, moved to the CHB transition area adjacent to the MDB UPA. At PBCDF, EONCs containing mine drums are delivered to the first floor UPA. In the CHB UPA (first floor UPA at PBCDF), the ONCs/EONCs are monitored for leaking mines/mine drums before being unloaded. At ANCDF and UMCDF, if agent is detected in an EONC, the EONC is returned to the first floor CHB lift area and taken by truck to the toxic maintenance area (TMA). The procedure at TOCDF allows for processing of leaker ONCs in the UPA if agent is detected below 40 TWA. If it is above 40 TWA they are taken to the TMA as stated. At PBCDF, if agent is detected in the EONC, the EONC is taken directly from the first floor UPA to the TMA. ONCs/EONCs with agent detected (see section 3.5) are unloaded in the TMA by personnel in DPE.

If agent is not detected in an ONC/EONC, the pallet of mine drums (see FAWB Note B-4) is removed from the ONC/EONC in the CHB UPA (first floor UPA at PBCDF). At ANCDF, TOCDF, and UMCDF, the pallet is removed from the ONC/EONC and

[4] The mine airlock equipment tag number, MHS-AIRL-101, is the tag number used at the CDTF. The site tag number may be different.

[5] The container handling building FAWB, programmatic process FAWB Book 30, contains more information about the CHB and the operations to support the movement of ONCs/EONCs to the CHB UPA adjacent to the MDB UPA.

delivered by forklift to the MDB UPA. The pallet is placed on the floor in a mine drum staging area for depalletization and ACAMS monitoring. At PBCDF, the pallet is removed from the EONC and delivered by forklift to the UPA lift car (UPA-LIFT-101) to transfer the mine drums from the first-floor UPA to the second-floor UPA. In the second-floor UPA, the pallet is unloaded from the lift by forklift and placed in a mine drum staging area for depalletization and ACAMS monitoring.

At all sites, UPA operators dismantle each pallet by snipping the banding wires and cutting them into a convenient size for handling. The operators snip the drum lid locking ring bolt, and remove the locking ring from the drum (see FAWB Note B-16). The cut banding wires, locking ring bolts, and any loose pallet packing material are hand-carried to a trash receptacle or dunnage container for disposal (see FAWB Note B-17).

While wearing an appropriate level of personal protective clothing and equipment (see FAWB Note B-5), UPA operators open mine drums using specialized tools and monitor for agent (see FAWB Note B-18). If agent readings are below acceptable levels, the drum is labeled as acceptable for unpacking. If agent is detected in the drum, the lid is placed back on; the drum is put on a tray assembly on a bypass line and conveyed into the ECV where workers in DPE can unpack it (see section 3.5).

When mine drums are opened for monitoring, UPA operators inspect the drums to ensure that the three fuzes and three activators are present in the top layer of packing material. If all six explosive components are not present, drums are set aside to verify that the explosive components are not installed[6] (see FAWB Note B-19). After the Army determines that the mines are safe to handle, the drums are handled the same as all other drums.

UPA operators continue opening mine drums until all drums designated for processing are opened and cleared for unpacking. At this point, the level of protective clothing and equipment for UPA operators can be reduced to facilitate removal of mines from mine drums (see FAWB Note B-6). UPA operators first remove the three fuzes and activators from the packing material and place them in an MCC. Rigorous accountability procedures will be implemented at CONUS sites to ensure all fuzes and activators are removed from packing material and placed in MCCs (see FAWB Note B-20). Once filled with three fuzes and three activators, the lid is placed on the MCC and the MCC is loaded onto an accumulation conveyor, or, at TOCDF, on the UPA mine feed conveyor.

After fuzes and activators are loaded into MCCs, UPA operators discard the top layer of packing material and proceed to remove mines from the drum. Mines are packed in drums upside down with the handle facing up. The bottom of the mine has a lip that extends ¼-inch out from the mine body. JACADS developed a pneumatic mine lifting assembly, which will be used at CONUS sites, to aid in the safety and ease of mine removal. The mine lifting assembly has a gripper device with three fingers that grip the mine 120 degrees apart. In the OPEN position, the gripper fingers expand so that the fingers can be placed over the mine, below the bottom lip. The UPA operator closes the gripper by placing the operating handle for the center-return control valve in the CLOSE

[6] JACADS SOP for UPA operations did not address handling of a drum with less than 3 mines. CONUS sites will need to determine how drums with less than three mines are to be handled.

GRIPPER position. The fingers clamp against the mine body and overlap the ¼-inch lip for secure lifting of the mine. The gripper fails in the CLOSE position. For additional safety, two distinct actions are required to open the grippers (see below).

The mine lifting assembly is attached to an electric hoist hung from a monorail that spans the distance from the unload area to the accumulation conveyor system or, at TOCDF, to the UPA mine feed conveyor. After closing the grippers, the UPA operator raises the mine up out of the drum to a height above that of the conveyor on which it will be placed. The UPA operator then moves the mine lifting assembly along the monorail from the unload area to the conveyor. The mine is lowered onto the receiving conveyor. The grippers are then opened by placing the operating handle for the center-return control valve in the OPEN GRIPPER position, and simultaneously depressing a release button on the exhaust port of the center-return control valve. The release button is positioned so that two hands are needed to perform the action required to open the grippers, thereby reducing the chance of inadvertently opening the grippers.

After opening the grippers, the mine lifting device is raised up and moved back to the unload area. The UPA operator manually turns the mine over so the arming plug is facing up. After verifying that the arming plug is in the SAFE position, the UPA operator moves the mine to one of the lanes in the accumulation conveyor system or, at TOCDF, to rocket/mine input conveyor no.1 (MMS-CNVM-102). If the arming plug is in the ARMED or DANGER position, site-specific protocol is followed to handle the mine.

The UPA operator proceeds until the mine drum is empty. Packing material that separates the mines in the drum is removed and placed in a trash receptacle or dunnage container for disposal (see FAWB Note B-17). Disposal of empty mine drums is discussed in section 3.3.4.

3.3.1.2 UPA Conveyor System

JACADS used an accumulation conveyor system in the UPA capable of storing 100 metal mines and 25 MCCs. Initial plans for TOCDF included a similar system, however, after careful consideration of safety issues and throughput requirements, TOCDF decided to use only a single feed conveyor (see FAWB Note B-21). ANCDF, PBCDF, and UMCDF sites may use similar systems or develop their own based on UPA space availability and throughput requirements.

TOCDF will use rocket/mine input conveyor no.1 (MMS-CNVM-102) in the UPA, which extends approximately nine feet into the UPA, measured from the ECV wall. The first few rollers of the conveyor are unpowered to facilitate placement of mines/MCCs on it prior to feed into the system. The powered conveyor section extends from the UPA, into the mine airlock, and ends at the mine airlock exit gate. Mines/MCCs placed on the rocket/mine input conveyor no.1 transfer from the UPA through the mine airlock onto rocket/mine input conveyor 2 (MMS-CNVM-103/104) in the ECV.

Because TOCDF will be processing mines/MCCs in ECR B, TOCDF rocket/mine input conveyor no.1 is controlled by ICS-CONR-104C, which is the same controller as ICS-CONR-104A (used for rocket line B), configured for mine processing. The conveyor runs continuously in AUTO as long as all interlocks are satisfied. The conveyor includes a feed

stop to meter mines/MCCs into the mine airlock. The feed stop and mine airlock are described in the following subsections.

At JACADS, the accumulation conveyor system provided buffer storage for mines/MCCS prior to delivery to the processing line. The JACADS system included 5 accumulation lanes, one take-away conveyor and a lift conveyor. The system was designed to hold 100 metal mines and 25 MCCs. The accumulation lanes were sloped gravity conveyors. The accumulation conveyor system was controlled by a vendor-supplied PLC. There was no data communication between the local PLC and the plant PLC. The equipment controlled by the plant PLC simply waited for a mine/MCC to arrive at the mine airlock entry gate. When a mine/MCC was detected there, the plant PLC began its AUTO transfer of mines/MCCs through the mine airlock into the ECV.

3.3.1.3 Mine Airlock Feed Stop

The mine airlock feed stop, consisting of two steel rods that are raised and lowered between the rollers of the conveyor, meters mines/MCCs into the mine airlock. The stop is positioned so that when raised only one mine/MCC can fit between the stop and the airlock entry gate. Thus, with the stop up and the gate closed, one mine/MCC is positioned at the airlock entry gate. When the gate is opened, a single mine/MCC moves into the airlock. The airlock gate closes when a mine/MCC is no longer detected at the airlock entrance and a mine/MCC is detected in the airlock. The stop lowers to feed the next mine/MCC if the mine system is in AUTO, no mine/MCC is detected at the airlock entry gate, the airlock entry gate is closed, and MMS-CONV-103/104 is running forward. There is no requirement for a mine/MCC to be present at the mine airlock feed stop in order to lower the stop. The stop simply remains down until a mine/MCC is detected at the airlock entry gate. When a mine/MCC is detected there, the stop raises to prevent the next mine/MCC from moving forward when the airlock entry gate opens.

3.3.1.4 Mine Airlock

Mines/MCCs are transferred from the UPA to the ECV through the mine airlock, which is equipped with pneumatically-operated entry and exit gates. The gates are interlocked so that both cannot be open at the same time.

The mine airlock separates the airspace of the UPA from the ECV, which prevents migration of agent vapors, if present, from the ECV back to the UPA. The airlock gates have proximity switches to indicate the open and closed positions. The gates are controlled by the PLC when the local hand switches are in the REMOTE position.

The airlock enclosure is ventilated by the MDB HVAC system. The airlock exhaust duct connects to ECV airspace, and has an HVAC isolation damper to prevent backflow of air from the ECV into the UPA in the event of a ventilation system upset. The inlet ventilation line draws air from the UPA.

In AUTO mode, the PLC raises the entry gate when a mine/MCC is detected at the gate, the mine airlock feed stop is raised, no mine/MCC is detected in the airlock, the airlock exit gate is closed, the conveyor is running forward, and there is room on mine input conveyor #2 to stage another mine/MCC in the ECV. When the gate opens, the mine/MCC is conveyed into the airlock and stopped by the closed exit gate. The conveyor runs

continuously during the airlock transfer sequence. When a mine/MCC is detected in the airlock and is no longer detected at the airlock entrance, the entry gate closes.

After the entry gate closes, the exit gate opens as long as the system remains in AUTO, the conveyor is running forward, and there is room on mine input conveyor #2 to stage another mine/MCC in the ECV. When the mine/MCC is detected by sensor 04-ZS-113 (04-ZS-241 at TOCDF) in the ECV and there is no longer a mine/MCC detected in the airlock, the airlock exit gate closes.

3.3.2 Mine Handling in the ECV

Mines/MCCs are conveyed into and through the ECV by rocket/mine input conveyor 2 (MMS-CNVM-103/104). The design specifies use of line A for mine processing. At the end of the line A conveyor is a swing roller that is used to bridge the gap between the end of the conveyor and the start of the MIN input conveyor in the ECR. The extra roller is required since mines are only 13.25 inches in diameter and need support as they transition from the conveyor in the ECV to the conveyor in the ECR. Line B was not equipped with a swing roller since it was designed to handle rockets only, which are long enough to bridge the gap without additional support. The swing roller is raised and lowered pneumatically and has an unpowered, free-rolling roller. The swing roller is hard-wired to raise/lower in concert with the ECR munition access blast gate (MMS-GATE-101).

Because TOCDF will be using line B, and rocket/mine input conveyor 2 on line B is not equipped with a swing roller, a powered swing roller is being added to the MIN input conveyor (see section 3.3.3).

Integral to rocket/mine input conveyor 2 is the mine metering input system, MHS-FEED-101, which is an interlocked dual stop mechanism used to isolate individual mines and control mine feed to the ECR (see FAWB Note B-8). The stops consist of two steel rods for each stop that are raised and lowered between the rollers of the conveyor. Mines are stopped by the raised stops while the conveyor rollers are still running. The stops cycle to allow feed of one mine at a time to the ECR. The first stop, the index stop, is raised whenever the mine system is in AUTO except when an AUTO-RETRACT command is received. The index stop is lowered after a mine has been released from the second stop, the feed stop, and the feed stop has been raised again. The index stop will lower only if the mine system is in AUTO, a mine is detected at the index stop, no mine is detected at the feed stop, the feed stop is raised, and rocket/mine conveyor 2 is running forward.

When the index stop lowers, the mine passes over the top and is stopped by the feed stop. When a mine is detected at the feed stop, the index stop extends, blocking the path of additional mines. To feed the mine into the ECR, the blast gate (MMS-GATE-101) opens, the swing roller raises, and the feed stop lowers. The feed stop lowers only if the mine system is in AUTO, a mine is detected at the feed stop, rocket/mine conveyor 2 is running forward, the swing roller is extended, the blast gate is open, and there is space in the ECR for another mine. The feed stop raises when a mine is no longer detected at the feed stop. When the mine is detected in the ECR, the swing roller lowers and the blast gate closes.

3.3.3 Mine Handling in the ECR

Mines and MCCs are conveyed into the ECR onto the MIN input conveyor from rocket/mine input conveyor 2 (MMS-CNVM-103/104) through the ECR munition access blast gate (MMS-GATE-101/102). At TOCDF, the MIN input conveyor will be equipped with a powered swing roller that bridges the gap between the end of rocket/mine input conveyor 2 and the start of the MIN input conveyor in the ECR.

The design at other sites specifies use of line A for mine processing. On line A, rocket/mine input conveyor 2 is equipped with a non-powered swing roller (see section 3.3.2). A powered swing roller was added at TOCDF because the line B rocket/mine input conveyor 2 is not equipped with a swing roller and because of problems JACADS had with the non-powered swing roller (see FAWB Note B-22). The configuration for ANCDF, PBCDF and UMCDF has yet to be determined.

Similar to the swing roller on line A, the pneumatically operated swing roller on the MIN input conveyor at TOCDF will be hard-wired to raise and lower in concert with the ECR munition access blast gate (MMS-GATE-102).

A set of pneumatically operated stops has been added to the MIN input conveyor to meter mines to the orientation station. The stops are not shown in the design for any of the sites, but are being added based on JACADS experience (see FAWB Notes B-23 and 24). The stops allow for up to 5 mines to be staged in the ECR during mine processing. The stops will operate similar to the mine metering input system except that they will also work in conjunction with the newly developed MCC verification system (see section 3.2.1.1), which initiates mine processing in the ECR.

3.3.4 Mine Drum Handling

In the original design, after mine drums are emptied in the UPA, the drums are placed into drum baskets on a bypass conveyor (tray conveyor at PBCDF). A total of eight empty drums are placed in the drum basket before it is conveyed to the MPF for decontamination of the drums.

JACADS did not use mine drum baskets and did not even process uncontaminated mine drums in the plant. Instead, uncontaminated mine drums were repalletized and transferred outside to a drum crusher area. Mine drums were removed from the pallets and crushed in a hydraulic drum crusher. Crushed drums were disposed of as scrap metal. Potentially contaminated drums that were unpacked in the ECV were placed into waste incineration containers (WICs) and thermally decontaminated in the MPF.

TOCDF plans to handle mine drums similar to JACADS. ANCDF, PBCDF, and UMCDF have yet to determine how mine drums will be discarded.

3.3.5 MHS Special Handling

At JACADS, damaged and/or deformed mine drums were not opened or processed in the UPA; they were treated the same as overpacked drums. See section 3.5 for processing of these items.

3.4 MHS INITIALIZATION, STARTUP, AND PARK

The first step in operating the MIN is to ensure that all the conditions are satisfied to allow the system to run. This includes the Limiting Conditions of Operation checklist and the pre-operational checklist. One of the conditions required is to select the proper campaign from the Campaign Select Screen (CSS). Since mines are only processed in ECR A, the operator must select the M23 entry under ECR A. The second task of the Campaign Selection is to choose the agent type to be processed. Once the selections are made, the operator must verify the selection by activating the VERIFY CAMPAIGN SELECTION icon and depressing the **START** key. If the proper selection has been made, the icon turns green to indicate that the system is configured for processing mines.

After the correct campaign has been selected and verified, the system must be initialized. The system initialization restores the machine from the PARK condition and prepares the line for processing. In order to initialize, the operator must have all associated equipment in automatic and the hydraulics configured for the machine. The mine machine's sequencer must also be in automatic to allow the initialize step to occur. To ensure a successful initialization, all emergency stops and rope switches must be reset.

Initialization prepares the line for processing by running all the conveyors forward and placing devices in the operating position. The conveyors are started in order to locate any mines remaining on the line from previous processing runs.

The initialization procedure is started by the operator accessing the Mine Initialize Screen (MNI) and selecting the SYSTEM INITIALIZE icon and depressing the **START** key. Before the equipment will start initializing, however, the warning horns will sound for ten seconds and the warning lights will illuminate to notify plant personnel that the line is about to start. If the equipment was previously running within the last ten minutes, the warning lights will still be illuminated but the warning horns are not required to sound. If the horns are required to sound, the horns will be silenced after the ten second delay and the equipment will commence the initialization sequence. After the system has been initialized successfully, the icon will go from a flashing green to a steady green. This notifies the operator that the system is now available to be placed in the run mode and begin processing. In the event the initialization attempt fails, an alarm is generated and the icon will flash red. When the fail to initialize alarm is acknowledged, the failed station will attempt to initialize again.

After a successful system initialization, the MHS can be placed into operation. Prior to operation, there are several interlock conditions that have to be satisfied. The system must verify that all the necessary utilities are up and running, the DFS and the TOX are ready for processing, and that the ECR A man doors and blast gates are secured. Also, the rope switches and local emergency stops must all be reset. When all the conditions are satisfied, the operator can then issue the SYSTEM START command by accessing the MNI screen and selecting the SYSTEM START/STOP icon and depressing the **START** key. If all the conditions for system start are met, the icon on the MNI screen will be displayed in green and all continuously running devices will be started.

When the processing run is completed, the system should be parked. The PARK function drives all the hydraulic devices to a safe shutdown position or to the gravity driven state and de-energizes all outputs.

The system must be stopped prior to issuing the PARK command. Before stopping the system, however, the operator should visually check the line for any remaining mines. This will aid in the startup of the next processing run. To stop the automatic operation, the operator accesses the MNI screen and selects the SYSTEM START/STOP icon and depresses the **STOP** key. The SYSTEM START/STOP icon turns to magenta indicating the system has been stopped. To initiate the park function, the operator accesses the MNI screen, selects the PARK MACHINE icon and depresses the **START** key. Once the machine stations have completed parking, the icon goes from a flashing green to a steady green state. In the event the park attempt fails, an alarm is generated and the icon will flash red. The cause of the failure must be corrected before the alarm is acknowledged. Once the cause of the failure has been corrected, the operator accesses the MNI screen and depresses the **ACKNOWLEDGE** key. The PARK MACHINE icon will return to magenta. At this time, the operator must reselect the PARK MACHINE icon and depress the **START** key again. The failed station will then attempt to park again.

3.5 MINE LEAKER HANDLING

If agent is detected within a stockpile structure (igloo) containing land mines, the leaking drum is identified, removed from its pallet configuration, decontaminated and placed in an overpack (75-gallon plastic container[7]). Overpacked drums are then transferred to a separate storage igloo for continued storage.

Overpacked mine drums are delivered in ONCs/EONCs to the UPA similar to nonleaking munitions. Overpacked mine drums are loaded onto the bypass line turntable (tray input conveyor at PBCDF), conveyed through the airlock into the ECV, and unpacked by workers in DPE. Overpacks are lifted off the bypass line using an ECV monorail crane and placed on the ECV floor. ECV operators open the overpacks, remove the drums using a drum lifting fixture attached to the ECV crane, place the mine drum on the ECV floor, and open the drums. Fuzes and activators are removed and put in MCCs, which are then placed on rocket/mine input conveyor 2. Mines are removed manually and placed on the same conveyor. The overpack, mine drum, and packing materials are placed into a WIC and transferred to the MPF for thermal decontamination.

Leaking mine drums can also be detected after delivery of a loaded ONC/EONC to the CHB unpack area (CHB UPA) where the ONCs/EONCs are monitored before being unloaded (see section 3.3.1.1). If an ONC/EONC is found to contain a leaking mine drum, the ONC/EONC can be taken to the TMA. Pallets with leaking mine drums are unloaded from the ONC/EONC by personnel in DPE in the TMA. At ANCDF, TOCDF, and UMCDF, mine drums are placed on a munitions tray and conveyed out of the TMA onto the lower munitions corridor charge car and run backwards along the bulk conveyor lines into the ECV (see the bulk container handling systems programmatic process FAWB, Book 24 for more information on the bulk conveyor lines). At PBCDF, the mine

[7] The 75-gallon plastic container is the overpack identified in design documentation. JACADS did not encounter any 75-gallon containers as overpacks. Instead, they processed 43 mine drums that were overpacked in either 55-gallon or 85-gallon drums. When unpacked in the ECV, none of these mines were found to be actual leakers. The drums had been overpacked because of corrosion or damage to the drums.

drums are placed on a munitions tray on the TMA conveyor (TMA-CNVP-102) and conveyed out of the TMA to the BDS room onto the overpack conveyor (MMS-CNVP-134). The mine drums are moved from the overpack conveyor to ton container conveyor 3 (MMS-CNVP-136) using the BDS monorail (BDS-MONO-401) and then into to the lift car (MMS-LIFT-101) in the BDS room. The mine drums are lifted to the COR on the second floor and conveyed back from the COR to the ECV.

In the ECV, workers in DPE unpack the leaking mine drums in the same manner as overpacked mine drums.

Leaking mines may not be detected in a storage igloo or in an ONC/EONC when it is delivered to the MDB. Instead a leaking mine may go undetected until the drum is opened and monitored in the UPA (see section 3.3.1.1). If agent is detected, or if liquid is observed in a drum after it is opened in the UPA, the drum lid is immediately placed back on and the drum is labeled, DPE PROCESSING ONLY[8]. Using a drum lifting fixture and an overhead crane, the drum is placed on a tray assembly on a bypass input conveyor. The drums with suspected leakers are conveyed into the ECV where workers in DPE unpack the mine drums in the same manner as overpacked mine drums.

3.6 MINE DUNNAGE HANDLING

Both uncontaminated and contaminated dunnage can be generated during the unpacking processes for the mine drum pallets and mine drums in the UPA. The pallet unpacking dunnage consists of wooden pallet straps, clips, and any other packing material separating or surrounding the mine drums. If a pallet does not contain any leaking mine drums, the pallet dunnage is treated as uncontaminated dunnage. If a pallet contains a leaking mine drum, the dunnage is treated as contaminated dunnage.

Dunnage from unpacking mine drums consists of the mine drum lid, and packing material for the fuzes/activators and individual mines. At JACADS, if ACAMS sampling of the mine drums did not detect the presence of agent, the drums and packing material were disposed of as nonhazardous waste. If agent was detected, all materials from the drum were considered contaminated and were processed through the MPF as miscellaneous waste.

The original CSD project design included use of the dunnage incinerator (DUN) to process both contaminated and uncontaminated dunnage. None of the four CONUS sites, however, plan to operate the DUN. Handling and disposal of contaminated and uncontaminated dunnage are considered site-specific activities that have not yet been determined (see FAWB Note B-1).

[8] Drum labeling is based on JACADS SOP JI-0000-M-113. CONUS sites may use different labeling to identify mine drums with suspected leakers.

SECTION 4
COMPONENT SUMMARY

4.1 MHS COMPONENTS

Design documentation shows the use of a mine glovebox (MIG) for unpacking of mine drums in the UPA, and also includes a burster punch station (BPS) in the ECR. JACADS processed mines without using the MIG and BPS. Instead of using the MIG, UPA operators unpacked mine drums and placed the mines on an accumulation conveyor system, which conveyed the mines into the ECV through a mine airlock. The BPS was replaced with the fuzewell adapter removal station (FARS). PMCD has approved the use of equipment similar to the JACADS configuration for mine handling and processing at CONUS sites.

The following sections describe mine handling and processing equipment based on the JACADS configuration, with revisions based on enhancements being developed at the CDTF and site-specific modifications being identified for TOCDF implementation. Design documentation will be revised to show the actual equipment and process as they are implemented. The MHS components are presented based on where they are located: the UPA, ECV, and ECR.

4.1.1 UPA MHS Components

MHS components in the UPA at TOCDF include the use of a UPA monorail crane (UPA-MONO-402/403), the mine grippers, and rocket/mine input conveyor no.1 and airlock assembly (MMS-CNVM-102). JACADS also had accumulation conveyors and a take-away conveyor. ANCDF, PBCDF, and UMCDF sites may use a system similar to JACADS or TOCDF, or develop their own, based on UPA space availability and throughput requirements.

4.1.2 ECV MHS Components

Mines enter the ECV from the mine airlock onto rocket/mine input conveyor no.2 (MMS-CNVM-103/104)[1]. The mine metering input system (MHS-FEED-101), which is an integral part of rocket/mine input conveyor 2, controls mine feed to the ECR.

4.1.3 ECR MHS Components

Mines enter the ECR through the munition access blast gate (MMS-GATE-101/102) from rocket/mine input conveyor no.2 (MMS-CNVM-103/104). Mines first travel over the

[1] The design specifies the MIN to be installed in ECR A. TOCDF found that because of equipment configurations, campaign changeover times, and scheduling, it would be more efficient to install the MIN in ECR B. The ANCDF, PBCDF, and UMCDF systems contractors will determine which ECR they use for mine processing. Equipment tags numbers for both lines are included in the FAWB.

powered swing roller, which is part of the mine machine (MIN) input (feed) conveyor. The MIN has five processing stations: 1) the MCC verification station, 2) the orientations station (OS), 3) the punch and drain station (PDS), 4) the trolley transfer station, and 5) the FARS. The MCC verification station is an integral part of the MIN input conveyor; its primary components are the MCC verification cylinder and the MCC verification station stop pins. Mines enter the yoke assembly at the OS, which uses a lift table, orientation cylinder, and the orientation motor. The PDS uses a yoke stop, a drain clamp and a drain punch. The trolley transfer station uses a trolley to transfer mines/MCCs from the yoke assembly to the FARS. The FARS has a disc and pin assembly with pneumatic cylinder and hydraulic unthread motor, an antirotation bar, a stripper plate, and a holdback assembly. Mine processing also uses the AQS system, and a DFS feed gate assembly (see FAWB Note B-14). The MHS has automatic control interlocks, and process sensors and instrumentation. The MIN will be installed during the operations phase of the facility, just before the mine campaign.

4.2 EQUIPMENT POWER SOURCES

Table 4.1 lists the equipment power sources for the major equipment used in the MHS based on the source documentation listed in Appendix H. Power sources are characterized as either critical, essential or utility. Critical loads are powered by the UPS panelboards and do not experience an interruption in power if offsite power is lost. Essential loads are required for safe shutdown of the facility, but can tolerate an interruption in power while being loaded on an onsite emergency diesel generator (EDG). Utility loads are not required if offsite power is lost and are not powered by the onsite EDG. Instrumentation power sources are not listed.

Many items listed in Table 4.1 are in the design but they will not be used during the mine campaign. They are listed for informational purposes only.

Table 4.1. MHS Equipment Power Sources.

Equipment ID	Description	Site(s)	Power Source	Power Type
MHS-CNVP-101[1]	Drum Feed Scissor Lift Conveyor	AN/TE/UM	SPS-MCC-103	Utility
		PB	SPS-MCC-104	Utility
MHS-CNVP-102[1]	Mine Sorting Conveyor	AN/TE/UM	SPS-MCC-103	Utility
		PB	SPS-MCC-104	Utility
MHS-CNVP-103[1]	Trash Conveyor w/ Chute	AN/TE/UM	SPS-MCC-103	Utility
		PB	SPS-MCC-104	Utility
MHS-CNVP-104[1]	Mine Conveyor	AN/TE/UM	SPS-MCC-103	Utility
		PB	SPS-MCC-104	Utility
MHS-CNVP-105[1]	Airlock Roller Conveyor	AN/TE/UM	SPS-MCC-103	Utility
		PB	SPS-MCC-104	Utility
MHS-HOIS-101[1]	Mine Hoist	AN/TE/UM	SPS-MCC-103	Utility
		PB	SPS-MCC-104	Utility

Table 4.1. (Cont'd)

Equipment ID	Description	Site(s)	Power Source	Power Type
MHS-HOIS-102[1]	Drum Hoist	AN/TE/UM	SPS-MCC-103	Utility
		PB	SPS-MCC-104	Utility
MHS-HOIS-103[1]	Drum Lid Hoist	AN/TE/UM	SPS-MCC-103	Utility
		PB	SPS-MCC-104	Utility
MHS-EMAG-101[1]	Mine Magnet	AN/TE[2]/UM	UPS-PANB-108	Critical
		PB	NA[3]	NA[3]
MHS-EMAG-102[1]	Drum Magnet	AN/TE[2]/UM	UPS-PANB-108	Critical
		PB	NA[3]	NA[3]
MHS-EMAG-103[1]	Drum Lid Magnet	AN/TE[2]/UM	UPS-PANB-108	Critical
		PB	NA[3]	NA[3]
MHS-FEED-101A&B[4]	Mine Metering Input System	AN	SPS-PANB-151	Utility
		PB/UM	NA[4]	NA[4]
		TE	SPS-MCC-103	Utility
MMS –CNVM-102	Rocket/Mine Input Conveyor No.1 and Airlock Assembly (B)	TE	SPS-MCC-104	Utility
MMS –CNVM-103	Rocket/Mine Input Conveyor No.2 (A)	AN/UM	SPS-MCC-103	Utility
		PB	SPS-MCC-104	Utility
MMS –CNVM-104	Rocket/Mine Input Conveyor No.2 (B)	TE	SPS-MCC-104	Utility

[1]Equipment is specified in the design but will not be used for mine processing. See section 4.1.

[2]Listed on TE-1-E-74/1 as a spare circuit to ceiling of UPA near mine glove box.

[3]Power sources for these loads are not specified in the referenced PBCDF design documentation. Because these devices will not be used for mine processing (see note 1 above), the design will not be revised to specify the power source. Instead, the devices will be deleted from the design.

[4]MHS-FEED-101A&B, which are specified in the design as electrically operated devices, will be replaced with pneumatically operated ones (see FAWB Note B-8). Referenced PBCDF and UMCDF design documentation do not specify a power source for MHS-FEED-101A&B. Because of the change from electric to pneumatic stops, the design will not be changed to specify a power source.

APPENDIX A

Acronyms and Abbreviations

The acronyms and abbreviations listed below are common for all of the programmatic process FAWBs:

A&I	alarm and interlock matrix
AASS	automatic agent sampling system
ABCDF	Aberdeen Chemical Agent Disposal Facility
AC	alternating current
ACAMS	automatic continuous air monitoring system
acfm	actual cubic foot per minute
ACS	agent collection system
ACSWS	acid and caustic storage and wash system
ADC	air dilution controller
AgF	silver fluoride
AHT	agent holding tank
AHU	air handling unit
AMC	Army Materiel Command
ANAD	Anniston Army Depot (Alabama)
ANCDF	Anniston Chemical Agent Disposal Facility
ANSI	American National Standards Institute
AQS	agent quantification system
AR	Army Regulation
ASA	automatic submerged arc
ASC	allowable stack concentration
ASD	adjustable-speed drive
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	acid wash system
AWFCO	automatic waste feed cutoff
BCHS	bulk container handling system
BCS	bulk chemical storage
BDS	bulk drain station
BGCDF	Blue Grass Chemical Agent Disposal Facility
BLAD	blast load attenuation duct
BMS	burner management system
BPS	burster punch station (MIN)
BRA	brine reduction area
BRS	burster removal station (PMD)
BSA	buffer storage area
BSR	burster size reduction machine
Btu	British thermal unit
°C	degrees Celsius
CAMDS	Chemical Agent Munition Disposal System
CAB	combustion air blower
CAL	chemical assessment laboratory
CAS	compressed air system

CBR	chemical, biological, and radiological (filter)
CCB	configuration control board
CCS	central control system
CCTV	closed-circuit television
CDS	central decontamination supply
CDSS	central decontamination supply system
CDTF	Chemical Demilitarization Training Facility
CEHNC	U.S. Army Engineering & Support Center, Huntsville.
CEMS	continuous emission monitoring system
CFR	Code of Federal Regulations
CGA	Compressed Gas Association
CHB	container handling building
CHWS	chilled water supply
CO	carbon monoxide (monitors/analyzers)
COM	communications system
CON	control room
COR	munitions corridor
CPA	client-Parsons authorization
CRO	control room operator
CRT	cathode ray tube
CS	crimp station (PMD)
CSS	campaign select screen
CSD	Chemical Stockpile Disposal (Project)
CV	control variable
CWC	Chemical Weapons Convention
CWS	chilled water supply
DAAMS	depot area air monitoring system
db	dry bulb
DC	direct current
DCD	Deseret Chemical Depot
DDESB	Department of Defense Explosives Safety Board
decon	decontamination (solution)
demil	demilitarization
DFS	deactivation furnace system
DICI	digital intercontroller communication input
DICO	digital intercontroller communication output
DMS	door monitoring system
DPE	demilitarization protective ensemble (suit)
DSA	DPE support area
dscf	dry standard cubic foot
DSIC	design and systems integration contractor
DUN	dunnage incinerator
E&M	engineering and maintenance
E-stop	emergency stop
EAC	equipment acquisition contractor
ECF	entry control facility
ECP	engineering change proposal
ECL	engineering control level
ECR	explosive containment room
ECV	explosive containment vestibule
EDG	emergency diesel generator
EHM	equipment hydraulic module

EIC	equipment installation contractor
EONC	enhanced onsite container
EPS	emergency power system
ETL	extreme temperature limit
°F	degrees Fahrenheit
FARS	fuzewell assembly (or adapter) removal station
FAWB	functional analysis workbook
FDLL	field design lessons learned (program)
FDPS	fire detection and prevention system
FEET	FAWB evolvement/evaluation team
FEM	fire extinguishing medium
FIFO	first-in-first-out
FIL	activated carbon and HEPA filter
FPD	flame photometric detector
fpm	feet per minute
FSSS	flame safety shutdown system
ft	feet
GA	general arrangement; nerve agent ethyl N-dimethylphosphoramidocyanidate ($C_5H_{11}N_2O_2P$)
gal	gallon
GB	nerve agent Sarin, isopropyl methyl phosphonofluoridate ($C_4H_{10}FO_2P$)
GC	gas chromatograph
GEN	emergency generator
GFE	government-furnished equipment
GLD	gross level detector
GPD	gas plasma display
gpm	gallons per minute
gr	grain
H	blister agent mustard, made by the Levinstein process, Bis(2-chloroethyl) sulfide or 2,2'-dichlorodiethyl sulfide ($C_4H_8Cl_2S_{1.5}$ [empirical formula])
H_3PO_4	orthophosphoric acid
HCl	hydrochloric acid
HD	blister agent distilled mustard, Bis(2-chloroethyl) sulfide or 2,2'-dichlorodiethyl sulfide ($C_4H_8Cl_2S$)
HDC	heated discharge conveyor
HDV	hydraulic directional control valve
HEPA	high-efficiency particulate air (filter)
HLE	high-level exposure
HOA	hand-off-auto
hp	horsepower
hr	hour
HRA	health risk assessment
HT	60% by weight blister agent distilled mustard and 40% agent T [Bis[2(2-chloroethylthio)ethyl] ether]
HVAC	heating, ventilating, and air-conditioning
HVC	heating, ventilating, and cooling
HYD	hydraulic power
HYPU	hydraulic power unit
HYVM	hydraulic control valve manifold
I/O	input/output
I-lock	interlock

IAS	instrument air system
icfm	inlet cubic foot per minute (acfm at the inlet)
ICS	instrumentation and control system
ID	induced draft
	inside diameter
IDLH	immediately dangerous to life and health
IGS	inertial gas sampling
in.	inch
in. wc.	inches water column
IR	infrared
ISO	International Standards Organization
JACADS	Johnston Atoll Chemical Agent Disposal System
kW	kilowatt
L	Lewisite (blister agent)
LAB	laboratory
lb	pound
lb/hr	pounds per hour
LCO	limiting condition of operation
ln	line
LIC	liquid incinerator
LIFO	last-in-first-out
LIT	level-indicating transmitter
LOQ	limit of quantification
LOR	local-off-remote
LPG	liquefied petroleum gas
LQCP	laboratory quality control plan
LR	local-remote
LSB	LSS bottle filling system
LSS	life support system
LVS	low volume sampler
mA	milliamperes
MCC	motor control center
	mine component container
MCP	monitoring concept plan
MDB	munitions demilitarization building
MDM	multipurpose demilitarization machine
MEL	master equipment list
MER	mechanical equipment room
mg/m^3	milligrams per cubic meter
MIG	mine glovebox
MIN	mine machine
MMS	mine and munitions system
MPB	munitions processing bay
MPF	metal parts furnace
MPL	multiposition loader
	maximum permissible limit (for DPE)
MPRS	miscellaneous parts removal station (PMD)
MSB	monitor support building
MSS	munition sampling system
NaOCl	sodium hypochlorite
NaOH	sodium hydroxide
NCRS	nose closure removal station (PMD)

NEMA	National Electrical Manufacturers Association
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NG	natural gas
NRT	near real time
O&M	operations and maintenance
OBV	observation corridor
ONC	onsite container
OS	orientation station (MIN)
OSHA	Occupational Safety and Health Administration
OVT	operational verification testing
P&A	precision and accuracy
P&ID	piping and instrument diagram
PA	public address
PAS	pollution abatement system
PBA	Pine Bluff Arsenal
PBCDF	Pine Bluff Chemical Agent Disposal Facility
PCS	primary cooling system
PCT	preconcentrator tube
PDAR(S)	process data acquisition and recording system
PDE	projectile deformation equipment
PDIT	pressure differential indicator transmitter
PDS	pull and drain station (MDM) punch and drain station (MIN)
PFD	process flow diagram
PFS	PAS filter system
pH	potential of hydrogen (a measure of acidity or alkalinity)
PHS	projectile handling system
PID	proportional integral derivative
pig	overpacked shipping container
PKPL	pick-and-place machine (also PPL)
PLA	plant air system
PLC	programmable logic controller
PLL	programmatic lessons learned (program)
PLS	proximity limit sensor/switch
PMB	personnel and maintenance building
PMCD	Program Manager for Chemical Demilitarization (formerly PEO-PM Cml Demil)
PMCSD	Project Manager for Chemical Stockpile Disposal
PMD	projectile/mortar disassembly (machine)
PML	personnel, maintenance, and laundry (complex or building)
POT	potable water
PPL	pick-and-place machine (also PKPL)
PPS	primary power system
PQAP	Participant Quality Assurance Plan
PRW	process water
PSB	process support building
psig	pounds per square inch, gauge
PSV	pressure safety valve
PUB	process and utility building
PUDA	Pueblo Depot Activity (Colorado)
PWR	power systems (unit substation, uninterruptible power supply, battery rooms, and emergency generator)

RCRA	Resource Conservation and Recovery Act
RDS	rocket drain station
RDTE	research, development, testing, and evaluation
RFI	Request for Information
RHA	residue handling area
RHS	rocket handling system
rpm	revolutions per minute
rps	revolutions per second
RSM	rocket shear machine
RSS	rocket shear station
SC	systems contractor
SCBA	self-contained breathing apparatus
scf	standard cubic foot
scfh	standard cubic feet per hour
scfm	standard cubic feet per minute
SCW	secondary cooling water
SCT	systems contractor for training
SDS	spent decon system
sg	specific gravity
SGS	steam generation system
SOP	standing operating procedure
SPS	secondary power system
SRS	slag removal system
TBD	to be determined
TCE	treaty compliance equipment
TEAD	Tooele Army Depot (Utah)
TIP	tray information packet
TM	Army Technical Manual
TMA	toxic maintenance area
TNT	trinitrotoluene (explosive)
TOCDF	Tooele Chemical Agent Disposal Facility
TOX	toxic cubicle
TSCA	Toxic Substances Control Act
TSHS	toxic storage and handling system
TSO	Tight shutoff
TWA	time-weighted average
UE&C	United Engineers and Constructors
UMCDF	Umatilla Chemical Agent Disposal Facility
UPA	unpack area
UPS	uninterruptible power supply
UV	ultraviolet
VCR	video cassette recorder
VX	nerve agent, O-ethyl S-(2-diisopropylaminoethyl) methylphosphonothiolate ($C_{11}H_{26}NO_2PS$)
wc	water column
WTS	water treatment system
XXX	3X level of decontamination
XXXXX	5X level of decontamination (minimum of 1000°F for 15 minutes)
Z	general designation for monitoring hazard level

APPENDIX B

FAWB Notes

Appendix B contains notes to expand upon the descriptions contained in the text of the FAWB. The notes include related experiences at the Johnston Atoll Chemical Agent Disposal System (JACADS).

B-1 Per discussions held during the comment resolution matrix meeting for the HVAC FAWB on 9-10-98, the programmatic process FAWBs were prepared under the assumption that the DUN, DUN PAS and DUN PFS (at ANCDF) systems will not be used for processing at any of the four sites. Therefore, a programmatic process FAWB for the DUN/DUN PAS/PFS was not developed. Handling and disposal of dunnage are considered site-specific activities that have not yet been determined. PBCDF deleted the DUN from the design by PBAC1000DUN. The DUN is installed at TOCDF and remains in the design at ANCDF. The RCRA and design package for the UMCDF DUN, DUN PAS, and DUN PFS were incorporated under post-construction design update package PC2. The redesigned DUN package PC2, however, was not incorporated into the UMCDF RCRA Permit. The regulators were directed to not review the package. Instead, UMCDF is still trying to determine its best course of action to process both dunnage and spent charcoal.

B-2 Per discussions held during the comment resolution matrix meeting for the PAS FAWB on 11-10-98, the programmatic process FAWBs for the PAS and PFS have been combined into a single PAS/PFS FAWB that applies to ANCDF, PBCDF, TOCDF, and UMCDF.

B-3 The acid/caustic storage and wash system is no longer used at TOCDF and has been removed from the ANCDF, UMCDF, and PBCDF site designs by ECPs ANAC343PAS, R1, UMAC160PAS, R1, and PBAC340PAS, respectively.

B-4 At JACADS, mine drums were repalletized in single layer pallets with 6 mine drums per pallet. The mine drums were originally palletized double high without a separator pallet, which made it impossible to unload the second layer of drums using a fork truck. In the original configuration, the second layer of drums would have to have been unloaded by hand, which would have been very labor intensive and could have negatively affected the processing rate. TOCDF plans to repalletize the mine drums similar to JACADS. ANCDF, PBCDF, UMCDF will evaluate their processing needs before deciding whether or not to repalletize mine drums. In the original pallet configuration, an ONC/EONC could fit one pallet of 12 drums. Repalletized, only one pallet of six drums will fit into an ONC/EONC.

B-5 JACADS originally required mine drums to be opened by operators wearing a level of personal protective equipment (PPE) with a supplied-air respirator (SAR) that was formerly defined as Army level-B with SAR. Later in the campaign, the level of dress was reduced from the former Army level-B with SAR to the former Army level B. Department of the Army Pamphlet (DA-PAM) 385-61, Toxic Chemical Agent Safety Standards, was revised in 2002 and has redefined the requirements for each level of PPE. The former Army level-B used at JACADS for opening and monitoring of the mine drums is equivalent to level-C PPE, as currently defined in DA-PAM 385-61. At CONUS sites, each site will determine the PPE level needed for UPA operators to open and monitor mine drums.

B-6 JACADS originally was going to require mine drums to be unpacked by operators in protective clothing that was formerly defined as Army level-D, with an apron. After being forced to change the monitoring method due to the unexpected packing material (see FAWB Note B-18), the required PPE level changed to a level that was formerly defined as Army level-C, with an apron. DA-PAM 385-61, Toxic Chemical Agent Safety Standards, was revised in 2002 and has redefined the requirements for each level of PPE. The former Army level-C with apron used at JACADS for mine drum unpacking does not correspond directly to one of the newly defined PPE levels in DA-PAM 385-61, but falls between the newly defined level C and level D requirements. At CONUS sites, each site will determine the PPE level needed for UPA operators to unpack mines.

B-7 JACADS experienced the following problems with the mine component container (MCC), or cardboard mines, as they were processed on the mine line: 1) velcro tabs stuck up and caused MCCs to get stuck 2) MCCs rode up on the mine airlock entry gate, 3) MCCs got stuck in the yoke, 4) MCCs got stuck at the swing roller (see FAWB Note B-22), 5) MCCs were deformed by a long upstream line of mines pushing against them, and 6) MCCs got stuck on trolley tracks. Many of the problems were addressed by changing the equipment configurations. Others were addressed by developing a new MCC. The new MCC has velcro on the bottom of the lid rather than having tabs. The new MCC is more robust and heavier to prevent deformation and ensure that it is conveyed successfully through the system.

B-8 The design specifies use of electrically operated stops for the mine metering input system. Because these items are cumbersome and heavy, they will be replaced at all sites with pneumatically operated stops that will be easier to transport and install in the ECV.

B-9 The MIN original design included a burster punch station (BPS) where a punch extended through the bottom of the mine and through the conical burster to remove the booster pellet. After PMCSD reevaluated the potential for an explosion using this processing configuration, the BPS was replaced with the fuzewell adapter removal station (FARS).

B-10 When the MIN was installed and tested at the CDTF prior to the JACADS mine campaign, the yoke was increased in size so that the mines rotated without hanging up on the sides. As a lessons-learned from the JACADS campaign, drain slots were added in the yoke to prevent agent accumulation in the yoke. JACADS had a few instances where an MCC soaked up enough agent that the cardboard swelled causing the MCC to stick in the yoke.

B-11 The MIN originally included sensor PLS-3, a proximity switch that was used to detect the mine side burster well. PLS-3 worked in conjunction with PLS-2, mine handle oriented sensor, to ensure that the mine was properly oriented prior to punching it. During CDTF testing, PLS-3 required frequent readjustment, which would have caused unnecessary processing delays. PLS-2 was found to provide sufficient reliability to ensure proper mine orientation. Therefore PLS-3 was removed.

B-12 The nominal agent fill for M23 land mines is listed as 10.5 lbs VX. JACADS found that they routinely drained more than 10.5 lbs from mines. JACADS researched this discrepancy and found that, according to MILSPEC MIL-M-46984D, mines were filled with 315 to 342 cubic inches of agent. With a density of 1.0083 g/cc at 20°C, this converts to 11.47 to 12.46 lbs per mine. CONUS sites may encounter similar agent fills.

B-13 In the original design, a proximity presence switch (PLS-9), which differentiates between mines and MCCs, was mounted at the BPS and was to be used to count the number of mines punched and drained. The totalizer would be updated on the last step of the mine sequencer. The MCCs would not be detected by the proximity switch and not counted. A PLC alarm would be generated if more than one non-metallic mine in a row was detected. JACADS did not use PLS-9 for counting mines. Mines were counted based on the determination at the OS.

PLS-9 was also not used to identify whether the item at the FARS was a mine or an MCC. The FARS simply operated the same regardless of the item at the station. When an MCC was processed, the disc and pin assembly rotated without removing anything.

An additional sensor, PLS-13, was added to sense the presence of either a mine or an MCC, which initiated the FARS sequence. PLS-13 was initially a photoelectric, retroreflective sensor, but was replaced with a fiber-optic sensor with air purge. The original sensor was subject to failure when steam rose up from the DFS gate.

B-14 The design specifies use of a mine hopper (MHS-HOPP-101) to direct mines to the RSM/BSR & MIN discharge blast gate, MMS-GATE-103/104. There was no hopper used at JACADS and no hopper is planned to be used at CONUS sites. Instead, a newly designed assembly will be used to ensure that components are

contained on the top of the gate and do not bounce off. The new assembly has steel plates that bolt onto the top flange of the gate and extend up to the level of the MIN. Above that is wire mesh that allows for unobstructed CCTV viewing of FARS and gate operations.

B-15 The universal AQS was developed to standardize the AQS at all sites. Originally, every AQS was to be "field fit" which would have created differences in construction, piping runs, and operation, not only between sites, but also between demil machines at each site. The universal AQS consists of a prefabricated skid that includes components that are interchangeable between the RSM, MIN, and MDM. When used for the RSM, additional strainers are used, and when used for the MDM, an agent verification system is added. The interchangeable portion consists of the AQS tank, level and flow instrumentation, and the AQS tank inlet, drain, and vacuum valves.

The universal AQS has a compact, low-profile design, approximately 6 ft in height and 5 ft wide, which allows for it to fit into the ECR adjacent to the RSM or MIN. It was designed to be easy to maintain by including components that are easy to replace in DPE. Standardization also simplifies maintainability by having parts that are interchangeable between all AQS stations.

B-16 JACADS developed two tools to assist with opening mine drums in the UPA. The first tool was used to manipulate the drums on the pallets and pry the lids off. The second tool was used to remove the mine drum ring by spreading the ring ends apart so that the ring could be lifted off the drum. The tools simplified and facilitated the task eliminate the need for the UPA operator to perform this task. Similar tools are expected to be used at CONUS sites for opening mine drums in the UPA.

B-17 Design documentation for all sites specifies that banding wires, locking ring bolts, any loose pallet packing material, and wooden pallet pieces be placed in a combustible dunnage basket for disposal in the dunnage incinerator (DUN). TOCDF does not use the DUN, and ANCDF, PBCDF and UMCDF do not plan to use it (see FAWB Note B-1). If the DUN is used, the dunnage basket will be placed on one of the bypass conveyor turntables (tray input conveyor at PBCDF) in the UPA. Alternatively, the dunnage basket could be transferred directly by forklift to the DUN.

B-18 JACADS developed a probe to penetrate the polystyrene cushions that were expected to separate the mines to allow ACAMS monitoring of the bottom head space. This probe was never used since the packing material was found to be pressed wood (i.e., palm leaves). CONUS sites will inspect a sampling of drums to determine the packing material. If drums contain polystyrene only, a probe similar to the JACADS one will be used to monitor the drum. If other packing

materials are found that cannot be penetrated by the ACAMS probes, the air above will be monitored, similar to the method used at JACADS.

B-19 At JACADS, if all three fuzes/activators were not in the top layer of packing material, the lid was placed back on the mine drum and the drum was set aside. The drum was marked as "FUZES/ACTIVATORS MISSING/DO NOT PROCESS." The U.S. Army verified that the fuzes and acivators were not installed before the mine drum contents were processed.

B-20 After completion of the JACADS VX mine campaign, eight fuzes and three activators were found mixed in with mine packing material waste. PMCD generated a RAC (risk assessment code) 2 safety deficiency based on inadequate procedures to screen and certify that the packing material was free of explosives prior to release of the material from the site as nonhazardous waste. CONUS sites will be required to implement rigorous explosives accountability procedures to ensure that all fuzes and activators are processed in MCCs. JACADS generated many recommendations to improve explosive component accountability, including double and triple checking on the quantity of energetics at various times during unloading/unpacking operations and using an accountability sheet with a numbering system to provide total accountability from start to finish.

B-21 Before deciding to use a single conveyor in the UPA to feed mines/MCCs into the ECV, an accumulation conveyor system was designed for TOCDF. The proposed system consisted of four accumulation lanes and a take-off conveyor that would deliver mines/MCCs to the mine airlock conveyor. The system was designed to hold 48 total items (36 metal mines and 12 MCCs) which are the contents of twelve mine drums (2 single-layer pallets). The lanes were powered conveyors to allow for all conveyors to be at the same height, which eliminated the need for a lift conveyor to raise the mines/MCCs to the level of the mine airlock conveyor. The accumulation lane conveyors would run continuously while mines/MCCs were loaded to ensure that mines/MCCs were conveyed to the take-away end of the conveyor. Each accumulation conveyor had a set of metering pins to feed one mine/MCC at a time to the take-away conveyor. The local PLC would cycle through each of the four accumulation lanes, feeding a single mine/MCC from each lane. After three mines/MCCs were transferred to the take-away conveyor, the three items were transferred to mine airlock conveyor.

B-22 JACADS found that cardboard mines were not always heavy enough to cross the non-powered swing roller and often got stuck at the roller. A second mine would be indexed in behind the stuck mine to dislodge it from the roller. A DPE entry would occasionally be required to free the stuck mine. In one instance, a mine fell at the swing roller and the gate (MMS-GATE-101) closed on the mine. This occurred when a mine got stuck at the swing roller, and a second mine was indexed to free the stuck mine. The operator did not put the gate, the swing roller, and both conveyors into manual, and there was a momentary gap between the

mines causing the “gate closed” sensor to clear. The swing roller dropped and the gate closed on the mine. The problem was resolved by lengthening the timer to wait five seconds between the “gate blocked” sensor clearing and the command to lower the swing roller and close the gate. The “gate blocked” retro-reflective sensor sending unit was also moved approximately two inches to better see a mine under the gate. The original sensor location and timing sequence were designed to look for a rocket blocking the gate. The rockets were a bigger target for the sensor to see. JACADS also experienced problems with the swing roller failing to raise or lower, which would require the swing roller to be reset in manual.

B-23 The JACADS mine campaign began with use of an arming plug extractor (APE) that removed the arming plug that was screwed into the mine pressure plate to provide a vent path for energetics as they burned in the DFS. The arming plugs were collected in a bin under the APE station. JACADS discovered that removal of the arming plug was not necessary so the station was bypassed from 14 November 2000 through the end of the campaign. The station was originally planned to be installed in the ECR. Lack of electrical connections and waste stream handling concerns necessitated relocation of the APE to the ECV (see FAWB Note B-24).

B-24 At JACADS, a set of stops was used to meter mines through the APE station (see FAWB Note B-23). When JACADS moved the APE station into the ECV, they left the metering stops in the ECR. JACADS used the metering stops to stage additional mines in the ECR, which resolved a timing conflict between the FARS and the inlet blast gate cycle. FARS operation, which is considered a hazardous operation that requires all blast gates to be closed, was delayed each cycle while the blast gate cycled to allow the next mine into the ECR. With staging of mines in the ECR, the gate was cycled immediately after the punch sequence was complete, which allowed the blast gate to close before the FARS was required to operate.

APPENDIX C

Alarm and Interlock Matrices

Appendix C contains a preliminary alarm and system response matrix for the MHS. The alarms and system responses are considered preliminary because complete code has not yet been developed for TOCDF MHS implementation. In addition, because the CDTF does not have the exact configuration as TOCDF (e.g., CDTF does not have a muniton access blast gate, MMS-GATE-101/102), CDTF's code does not have all of the system alarms and interlocks. The alarms and responses are based on CDTF code as of March 2002 and TOCDF as of February 2002.

Specific guidelines were developed during development of utility system FAWBs for ANCDF and UMCDF that are followed in the programmatic FAWBs[1]. Fourteen specific guidelines have been established that define the format and content of entries in the A&I matrices:

1. Analog signals from transmitters (e.g., LITs) are not listed; the alarms are indicated separately.
2. All software prealarms and alarms (e.g., LAHs) that are indicated in the CON are listed. Setpoints and actions are shown where applicable.
3. Equipment and instrument status indication signals (e.g., open/close, on/off) are not listed unless they initiate action.
4. Alarms generated from GFE package units that report to the PLC are listed. If not already available and listed, the GFE internal alarms and actions will be added to the matrix when available from the site systems contractor and "*SC to provide detail"* will be entered into the "remarks" column.
5. For field switch generated alarms, the switch tag is listed, not the alarm tag. For example, a low-low pressure alarm (PALL) generated by the field switch, 13-PSLL-008, is listed as 13-PSLL-008 rather than 13-PALL-008. The purpose for this listing is to distinguish between field switch generated hardwired alarms and alarms generated in the software based on the analog output from a transmitter.
6. Instruments that initiate actions are listed in a vertical column sorted by prefix, loop number, instrument ID, then suffix. For example, for 99-TSH-100A, the prefix is 99, the loop number is 100, the instrument ID is TSH, and the suffix is A). Actions are listed in column across the top of the matrix and include prealarms and alarms.

[1] For the MHS, because of the limited number of alarms, the specific guidelines have not been rigorously applied. All known alarms are listed, regardless of response.

7. Setpoints are listed for all instruments where applicable. Instrument ranges for analog transmitters are shown in Appendix F. Unless otherwise noted, tank level setpoints are shown from the level transmitter tap.

8. Only hand switches (push buttons) that cause system shutdowns are listed; other software and hardwired hand switches are not listed.

9. Local alarms are not listed.

10. Matrices are grouped by subsystem as applicable within each FAWB. For example, separate matrices are provided in the RHS FAWB for the rocket input feed assembly, the rocket drain station of the RSM, and the rocket shear station of the RSM.

11. Alarms associated with automatic actions are classified as *"alarms"* and alarms without automatic actions are classified as *"prealarms."*

12. Instruments listed in the matrix that are RCRA reportable are designated as such by entering *"RCRA"* in the Remarks column.

13. Clarifications are provided when necessary in the remarks column of the A&I matrices, or in the system and/or operator response column in alarm and system response tables.

14. Device malfunction alarms are not shown unless they initiate automatic actions such as equipment switchovers (e.g., to a standby pump), system shutdowns, or a stop feed signal.

Programmatic Alarm and System Response Table
Mine Handling System

LN	TAG NUMBER	DESCRIPTION	SYSTEM RESPONSE	ALARM BIT (B1:XXX/XX)[NOTE 1]
1	03-HDV-111	MMS-GATE-101 ECR ROCKET BLAST GATE MALFUNCTION	ALARM. TAG # FOR LINE A. TOCDF WILL USE LINE B (03-HDV-211 FOR MMS-GATE-102).	1460/11 (T)
2	03-XSH-127A	EXPLOSION IN ECR	ALARM - STOP EVERYTHING IN ECR. TAG # FOR LINE A. TOCDF WILL USE LINE B (03-XSH-227A)	1422/02 (T)
3	03-XS-160	MHS-MIN-101 03-XS-160 EMERGENCY STOP SWITCH ALARM	ALARM - STOP EVERYTHING IN ECR, PUT TO MANUAL. TAG # FOR LINE A. TOCDF WILL USE LINE B (03-XS-260)	TBD
4	03-XS-166	MHS-MIN-101 03-XS-166A&B MINE CONVEYOR ROPE SWITCH ALARM	ALARM - STOPS INPUT CONVEYOR.	1420/06 (T)
5	04-ZA-113	MMS-CNVM-103/104 MINE INPUT CONVEYOR #2 FULL	ALARM WHEN MINE/MCC DETECTED AT ZS-113 FOR 10 SECONDS. INTERLOCK MINE AIRLOCK EXIT GATE FROM OPENING. TOCDF TAG WILL BE ZS-241.	020/04 (C)
6	04-XY-111	MINE AIRLOCK ENTRY GATE MALFUNCTION	ALARM.	066/11 (C)
7	04-XY-112	MINE AIRLOCK EXIT GATE MALFUNCTION	ALARM.	067/11 (C)
8	04-XY-117	MINE AIRLOCK FEED STOP MALFUNCTION	ALARM.	065/11 (C)
9	04-XA-148	MMS-CNVM-103 MINE INPUT CONVEYOR #2 MALFUNCTION	ALARM. TAG # FOR LINE A. TOCDF WILL USE LINE B (03-XS-248 FOR MMS-CNVM-104)	1262/11 (T)
10	04-XS-198	MMS-CNVM-103 04-XS-198A&B ROPE SWITCH ALARM	ALARM . STOP CONVEYOR AND METERING PINS. TAG # FOR LINE A. TOCDF WILL USE LINE B (03-XS-298 FOR MMS-CNVM-104).	1220/00 (T)
11	04-HS-402	MHS-FEED-101A MINE METERING INDEX STOP MALFUNCTION	ALARM.	1260/11 (T)
12	04-HS-408	MHS-FEED-101B MINE METERING FEED STOP MALFUNCTION	ALARM.	1261/11 (T)
13	04-HS-518B	MMS-CNVM-103 SWING ROLLER MALFUNCTION	ALARM. FROM TOCDF CODE. SIMILAR ALARM WILL REPLACE THIS ONE FOR SWING ROLLER ON MIN INPUT CONVEYOR.	1471/11 (T)
14	44-1101	MHS-MIN-101 MINE MACHINE INPUT CONVEYOR MALFUNCTION	ALARM - STOPS DEVICE, PUT TO MANUAL	1461/11 (T)
15	44-1102	MHS-MIN-101 ORIENTATION LIFT TABLE MALFUNCTION	ALARM - STOPS DEVICE, PUT TO MANUAL	1462/11 (T)
16	44-1103	MHS-MIN-101 ORIENTATION MOTOR MALFUNCTION	ALARM - STOPS DEVICE, PUT TO MANUAL	1463/11 (T)
17	44-1103A	MHS-MIN-101 OS FAIL TO ORIENT	ALARM IF MINE IS NOT ORIENTED AFTER ORIENTATION MOTOR RUNS FOR 15 SECONDS. TIMER VALUE FROM CDTF CODE.	1421/02 (T)
18	44-1104	MHS-MIN-101 YOKE STOP MALFUNCTION	ALARM - STOPS DEVICE, PUT TO MANUAL	1464/11 (T)
19	44-1105	MHS-MIN-101 MINE TROLLEY MALFUNCTION	ALARM - STOPS DEVICE, PUT TO MANUAL	1465/11 (T)
20	44-1106	MHS-MIN-101 FARS MALFUNCTION	ALARM - STOPS DEVICE, PUT TO MANUAL	266/11 (C)
21	44-1107	MHS-MIN-101 DRAIN PUNCH MALFUNCTION	ALARM - STOPS DEVICE, PUT TO MANUAL	1467/11 (T)
22	44-1108	MHS-MIN-101 DRAIN CLAMP MALFUNCTION	ALARM - STOPS DEVICE, PUT TO MANUAL	1468/11 (T)
23	44-1109	MHS-MIN-101 YOKE ROTATING DRIVE MALFUNCTION	ALARM - STOPS DEVICE, PUT TO MANUAL	1469/11 (T)
24	44-1PLS01	MINE FAIL TO ARRIVE IN YOKE	ALARM IF NO MINE DETECTED IN YOKE FOR 10 SECONDS AFTER MCC VERIFICATION STATION DISCHARGE STOP IS LOWERED.	1420/00 (T)
25	44-1PLS11	MHS-MIN-101 44-I1-PLS-11 MINE ON TROLLEY LOCKOUT ALARM	ALARM - STOPS DEVICE, PUT TO MANUAL	220/02 (C) 1420/02 (T)
26	44-1ZS419	MINE FAIL TO LEAVE MCC VERIFICATION STATION	ALARM IF MINE STILL DETECTED AT DISCHARGE STOP 5 SECONDS AFTER IT IS LOWERED.	221/16 (C)
27	44-XA-PLS1	MHS-MIN-101 44-1-PLS-1 AND MCC VERIFICATION DON'T MATCH	ALARM - STOPS DEVICE, PUT TO MANUAL	TBD
28	44-XY-415	MCC VERIFICATION STATION FEED STOP MALFUNCTION	ALARM.	291/11 (C)
29	44-XY-416	MCC VERIFICATION STATION DISCHARGE STOP MALFUNCTION	ALARM.	292/11 (C)
30	51-LAH-754	ACS-TANK-108 51-LIT-754 AQS TANK LEVEL HIGH ALARM	SP = 25 IN. ALARM - STOP PUMP, CLOSE INLET VALVE. SEE NOTE 2. TOCDF PRELIMINARY TAG NUMBER IS 51-LIT-9001.	250/02 (C)

Programmatic Alarm and System Response Table
Mine Handling System

LN	TAG NUMBER	DESCRIPTION	SYSTEM RESPONSE	ALARM BIT (B1:XXX/XX)[NOTE 1]
31	51-PIT-752	ACS-TANK-108 INSUFFICIENT VACUUM	ALARM IF TANK PRESSURE > 9.0 PSIA 20 SEC AFTER INLET AND DRAIN VALVES CLOSED AND VACUUM VALVE OPEN. SEE NOTE 2. TOCDF PRELIMINARY TAG NUMBER IS 51-PIT-9002.	250/00 (C)
32	51-XV-757	ACS-TANK-108 INLET VALVE MALFUNCTION	ALARM. SEE NOTE 2.	274/11 (C)
33	51-XV-758	ACS-TANK-108 DRAIN VALVE MALFUNCTION	ALARM. SEE NOTE 2.	275/11 (C)
34	51-XV-759	ACS-TANK-108 VACUUM VALVE MALFUNCTION	ALARM. SEE NOTE 2.	276/11 (C)
35	71-XS-007A	MIN LINE A SHIFT SUPERVISOR CONTROL CONSOLE E-STOP ALARM	ALARM - STOP EVERYTHING, PUT TO MANUAL	1421/10 (T)
36	71-XS-027A	MIN LINE A LEAD OPERATOR CONTROL CONSOLE E-STOP ALARM	ALARM - STOP EVERYTHING, PUT TO MANUAL	1421/12 (T)
37	71-XS-087A	MIN LINE A DEMIL OPERATOR CONTROL CONSOLE E-STOP ALARM	ALARM - STOP EVERYTHING, PUT TO MANUAL	1421/14 (T)
38	71-XS-107A	MIN LINE A DEMIL OPERATOR CONTROL CONSOLE E-STOP ALARM	ALARM - STOP EVERYTHING, PUT TO MANUAL	1421/16 (T)
39	71-XS-127A	MIN LINE A DEMIL/FURNACE OPER CONTROL CONSOLE E-STOP ALARM	ALARM - STOP EVERYTHING, PUT TO MANUAL	1422/00 (T)
40	BPSTAINIT	MHS-MIN-101 FARS INITIALIZE MALFUNCTION ALARM	SYSTEM ALARM ONLY. TAG NUMBER FROM TOCDF CODE.	1484/11 (T)
41	DICI	FROM ICS-CONR-106. TOX HIGH LEVEL TANK	ALARM - STOP ACS-PUMP-108, CLOSE INLET AQS VALVE.	B4:019/01 (T)
42	DICI	FROM ICS-CONR-110. LOW ECR dP	ALARM - MINE SYSTEM START INTERLOCK	B4:027/01 (T)
43	DICI	FROM ICS-CONR-105. LOW PLANT AIR PRESSURE	ALARM - MINE SYSTEM START INTERLOCK	B4:017/00 (T)
44	DICI	FROM ICS-CONR-105. LOW INSTRUMENT AIR PRESSURE	ALARM - MINE SYSTEM START INTERLOCK	B4:017/01 (T)
45	DICI	FROM ICS-CONR-102. FIRE IN ECR-A OR ECR-B	ALARM - STOP PROCESSING IN BOTH ECR'S	B4:005/00 (T)
46	DICI	POWER FAILURE	ALARM - STOP PROCESSING IN BOTH ECR'S	B4:025/01 (T)
47	MIN_AGNT	ACS-TANK-108 INSUFFICIENT AGENT DRAINED FROM MINE	ALARM - PREVENTS MINE DRAIN SEQUENCE ADVANCE. SEE NOTE 2.	221/12 (C)
48	MINOTDRN	ACS-TANK-108 TANK NOT DRAINING	ALARM - PREVENTS MINE DRAIN SEQUENCE ADVANCE. ALARM IF TANK LEVEL > 1.5 IN AFTER DRAIN VALVE HAS BEEN OPEN FOR 10 SECONDS. SEE NOTE 2.	221/14 (C)
49	MMMACINIT	MINE METERING MACHINE INITIALIZE MALFUNCTION	SYSTEM ALARM ONLY	1282/11 (T)
50	MHSYSPARK	MINE METERING MACHINE INITIALIZE MALFUNCTION	SYSTEM ALARM ONLY	1482/11 (T)
51	XFERTO406	MINE FAIL TO ARRIVE AT MHS-FEED-101 FEED STOP	ALARM IF NO MINE DETECTED AT FEED STOP FOR 7 SECONDS AFTER METERING STOP IS LOWERED. NOTE: TIMER VALUE FROM CDTF.	1220/02 (T)
52	XFERFR406	MINE FAIL TO ARRIVE AT MIN INPUT CONVEYOR	ALARM IF NO MINE DETECTED AT ON MIN INPUT CONV FOR 10 SECONDS AFTER MHS-FEED-101 FEED STOP IS LOWERED. NOTE: TIMER VALUE FROM CDTF, BUT ALARM IS DISABLED IN CDTF CODE.	1420/16 (T)
53	OPCONESTP	MINE LINE OPERATOR CONSOLE E-STOP	ALARM FROM TOCDF CODE.	1205/03 (T)
54	BPSTAINIT	MHS-MIN-101 FARS INITIALIZE MALFUNCTION ALARM	SYSTEM ALARM ONLY. TAG NUMBER FROM TOCDF CODE.	1484/11 (T)
55	PDSTAINIT	MHS-MIN-101 PUNCH & DRAIN INITIALIZE MALFUNCTION ALARM	SYSTEM ALARM ONLY	1483/11 (T)

NOTE 1: ALARM BIT NUMBERS ARE FROM EITHER CTDF (C) OR TOCDF (T) CODE, WHICHEVER IS APPLICABLE.
NOTE 2: AQS SYSTEM TAG NUMBERS REFLECT CDTF SYSTEM; SITE TAG NUMBERS MAY BE DIFFERENT WHEN THEY INCORPORATE THE UNIVERSAL AQS INTO THEIR DESIGNS.

APPENDIX D

PLC Automatic Control Sequences

Appendix D contains a summary of PLC automatic control sequences based on the current CDTF and TOCDF PLC code for the mine handling system components. This appendix also includes the CDTF sequencer tables for the sequencers that control operation of the MIN.

The PLC automatic control sequence summaries were generated based on the control system rung ladders in the PLC code for the MHS equipment. The operator interface with the PLCs, the Advisor PC system, stores device information in a database that consists of *tags*, or database records used for storing all necessary information related to a device that is monitored or controlled by the Advisor PC system. **D6** tags are used for discrete devices that may be controlled from the control room. In this appendix, automatic control for all devices with **D6** tags are described, grouped by the Advisor PC screens on which they appear. Details related to **D6** device format can be found in the CSDP Control Systems Software Design Guide. Note that Advisor PC tag numbers may not match P&ID tag numbers exactly since Advisor PC tag numbers are labels in the code that refer to a device that may be more encompassing than the P&ID device.

Because the MHS PLC automatic control sequences will be similar for all four sites, the control sequences are listed in a single table for each screen (Tables D.2 thru D.4). As PLC code is developed for each of the sites, annotations will be made in the descriptions to indicate the differences, if any, between the control for the device at the different sites.

D.1 MHS PLC Automatic Control Sequences

MHS PLC code currently exists for the CDTF configuration and the original design configuration at TOCDF. It is planned to implement the CDTF machine control logic at TOCDF. Because the CDTF does not have the exact configuration as TOCDF (e.g., CDTF does not have a muniton access blast gate, MMS-GATE-101/102), and TOCDF does not have code for MHS modifications, neither site's code currently has logic for all MHS **D6** devices. Therefore, the logic for some devices is taken from the TOCDF PLC code and other logic is from the CDTF PLC code, whichever is applicable. The controller source for each device is indicated in the tables. The information in the tables is based on the CDTF control system rung ladders as of March 2002 and TOCDF control system rung ladders as of February 2002. One device, MHS Conveyor 1, has logic from the November 2000 JACADS code since logic does not exist at TOCDF or CDTF for the conveyor.

At TOCDF, control for the MHS will be provided by ICS-CONR-104C because TOCDF will be processing mines in ECR B. ICS-CONR-104C is the same controller as ICS-CONR-104A (used for rocket line B), configured for mine processing. The original design specified use of ECR A for mine processing with control by ICS-CONR-101C, which is the same controller as ICS-CONR-101A (used for rocket line A), configured for

mine processing. Therefore, the TOCDF logic presented includes tag numbers associated with ECR A rather than ECR B. For example, the logic refers to MMS-CNVM-103 and MMS-GATE-101, which are line A components. When TOCDF implements the code, it will be applied to the line B equivalent components, MMS-CVNM-104 and MMS-GATE-102.

The designs for ANCDF, PBCDF, and UMCDF specify use of ECR A for mine processing with control by ICS-CONR-101C, similar to the original TOCDF design. Therefore the line A component tag numbers accurately reflect the components that are specified to be used at these sites.

Plant PLC control of the MHS begins with the mine airlock feed stop. Control for the accumulation conveyor system that feeds mines to the mine airlock is provided by a local, manufacturer-supplied PLC. Logic for these conveyors was not available at the time this FAWB was written.

The MHS has three Advisor PC screens associated with its operation. The three screens described in this appendix for each MHS subsystem are listed in Table D.1.

Table D.1 MHS Advisor PC Screens

Advisor PC Screen Name	Process Screen Designation
Mine Handling System	MHS
Mine Demil Line	MIN
Mine Initialize	MNI

Table D.2. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MHS**

Device:	**MHS Conveyor 1**[1]
Advisor PC Tag:	NA
CONR:	JACADS C101
Driver Word:	FWD 202/REV 212
Driver Type:	NA
Auto Forward:	The auto forward relay will be active if the following conditions are satisfied: • MHS CNV#1 is in AUTO • Mine line is online
Auto Reverse:	None
Forward I-Lock:	The following conditions must be satisfied to allow the device to run forward: • CON E-Stop not active • MHS CNV#1 rope switch not pulled
Retract I-Lock:	The following conditions must be satisfied to allow the device to run in reverse: • MHS CNV#1 rope switch not pulled

[1] MHS Conveyor 1 logic is from JACADS code since CDTF does not have a separate conveyor in the UPA and the conveyor will be a new item at TOCDF. At CDTF, the conveyor section in the UPA is a mechanical extension of MMS-CNVM-103 and thus operates with the same logic as MMS-CNVM-103.

Device:	**Mine Airlock Feed Stop**
Advisor PC Tag:	X04XY117
CONR:	CDTF C121C
Driver Word:	0065
Driver Type:	8
Auto Extend:	The auto extend relay will be active if the following condition is satisfied: • Mine airlock feed stop “auto retract” is not active
Auto Retract:	The auto retract relay will be active if the following conditions are satisfied: • Mine system is in “Auto Run” • Mine airlock entry gate is closed (04-ZS-410B active) • Mine not present at mine airlock entrance (04-ZS-404 not active) • MMS-CNVM-103 mine conveyor #2 is running forward
Extend I-Lock:	The following conditions must be satisfied to allow the device to extend: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled

Table D.2. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MHS**

Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled • Mine not present at mine airlock entrance (04-ZS-404 not active)
Device:	**Mine Airlock Entry Gate**
Advisor PC Tag:	X04XY111
CONR:	CDTF C121C
Driver Word:	0066
Driver Type:	9
Auto Open:	The auto open relay will be active if the following conditions are satisfied: • Mine system is in "Auto Run" • Mine airlock feed stop is raised (04-ZS-409A active) • Mine airlock exit gate is closed (04-ZS-411B active) • Mine not present on MMS-CNVM-103 mine conveyor #2 in ECV at airlock exit (04-ZS-113 not active) • Mine not present in mine airlock (04-ZS-405 not active) • MMS-CNVM-103 mine conveyor #2 is running forward • Mine is present at mine airlock entrance (04-ZS-404 active) OR "mine entering airlock" relay is active (see below)
Auto Close:	The auto close relay will be active if the following conditions are satisfied: • Mine airlock entry gate "AUTO OPEN" relay is not active • Mine not present at mine airlock entrance (04-ZS-404 not active)
Open I-Lock:	The following conditions must be satisfied to allow the gate to open: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled • Mine airlock exit gate is closed (04-ZS-411B active) • Mine airlock feed stop is raised (04-ZS-409A active)
Close I-Lock:	The following conditions must be satisfied to allow the gate to close: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled

Relay:	The "mine entering airlock" relay (see above) is latched when the following conditions are satisfied:
	• Mine is present at mine airlock entrance (04-ZS-404 active)
	• MMS-CNVM-103 mine conveyor #2 is running forward
	• Mine airlock entry gate is open (04-ZS-410A active)
	
	The "mine entering airlock" relay (see above) is unlatched when either of the following conditions are satisfied:
	• Punch and drain station is initializing
	• All of the following
	  • "mine entering airlock" relay is active
	  • MMS-CNVM-103 mine conveyor #2 is running forward
	  • Mine is present in mine airlock (04-ZS-405 active)

Table D.2. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MHS**

Device:	**Mine Airlock Exit Gate**
Advisor PC Tag:	X04XY112
CONR:	CDTF C121C
Driver Word:	0067
Driver Type:	9
Auto Open:	The auto open relay will be active if the following conditions are satisfied: • Mine system is in "Auto Run" • Mine airlock entry gate is closed (04-ZS-410B active) • Mine is present in mine airlock (04-ZS-405 active) OR "mine exiting airlock" relay is active (see below) • Mine not present on MMS-CNVM-103 mine conveyor #2 in ECV at airlock exit (04-ZS-113 not active) • MMS-CNVM-103 mine conveyor #2 is running forward
Auto Close:	The auto close relay will be active if the following conditions are satisfied: • Mine airlock exit gate "AUTO OPEN" relay is not active
Open I-Lock:	The following conditions must be satisfied to allow the gate to open: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled • Mine airlock entry gate is closed (04-ZS-410B active)
Close I-Lock:	The following conditions must be satisfied to allow the gate to close: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled

Relay:	The "mine exiting airlock" relay (see above) is latched when the following conditions are satisfied:
	• Mine is present in mine airlock (04-ZS-405 active)
	• MMS-CNVM-103 mine conveyor #2 is running forward
	• Mine airlock exit gate is open (04-ZS-411A active)
	
	The "mine exiting airlock" relay (see above) is unlatched when either of the following conditions are satisfied:
	• Punch and drain station is initializing
	• All of the following
	  • "mine exiting airlock" relay is active
	  • MMS-CNVM-103 mine conveyor #2 is running forward
	  • Mine is present on MMS-CNVM-103 mine conveyor #2 in ECV at airlock exit (04-ZS-113 active)

Device:	**MHS-FEED-101A Mine Metering Index Stop**
Advisor PC Tag:	X04HS402
CONR:	TOCDF C101C
Driver Word:	1260
Driver Type:	8

Table D.2. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MHS**

Auto Extend:	The auto extend relay will be active if the following conditions are satisfied: • Mine metering machine is initializing or mine system is in "Auto Run" • Mine metering index stop "auto retract" is not active
Auto Retract:	The auto retract relay will be active if the following conditions are satisfied: • Mine system is in "Auto Run" • Mine is present at index stop (04-ZS-400 active) • Mine not present at metering feed stop (04-ZS-406 not active) • Mine metering feed stop is raised (04-ZS-407A active) • MMS-CNVM-103 Mine conveyor #2 is running forward
Extend I-Lock:	The following conditions must be satisfied to allow the device to extend: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled
Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled • Mine not present at metering feed stop (04-ZS-406 not active)
Device:	**MHS-FEED-101A Mine Metering Feed Stop**
Advisor PC Tag:	X04HS408
CONR:	TOCDF C101C
Driver Word:	1261
Driver Type:	8
Auto Extend:	The auto extend relay will be active if the following conditions are satisfied: • Mine metering machine is initializing or mine system is in "Auto Run" • Mine metering feed stop "auto retract" is not active
Auto Retract:	The auto retract relay will be active if the following conditions are satisfied: • Mine system is in "Auto Run" • Mine is present at feed stop (04-ZS-406 active) • Mine metering index stop is raised (04-ZS-401A active) • MMS-CNVM-103 Mine conveyor #2 is running forward • Swing Roller is extended • Mine system PDS sequencer is requesting a mine (see sequencer charts)
Extend I-Lock:	The following conditions must be satisfied to allow the device to extend: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled

Table D.2. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MHS**

Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled • MMS-GATE-101 Munition Access Blast Gate is open • MMS-CNVM-103 Swing Roller is extended
Device:	**MMS-CNVM-103 Mine Input Conveyor #2**
Advisor PC Tag:	X04HS145
CONR:	TOCDF C101C
Driver Word:	1262
Driver Type:	7
Auto Forward:	The auto forward relay will be active if the following conditions are satisfied: • Mine metering machine is initializing OR mine system is in "Auto Run" and either no mine is present on the conveyor or Mine system PDS sequencer is requesting a mine (see sequencer charts) • "Mine input conveyor full" alarm is not active (04-ZS-141 not active) • "Mine Fail to Arrive at Feed Stop" alarm is not active • "Mine Fail to Transfer to Input Conveyor" alarm is not active
Auto Reverse:	None.
Forward I-Lock:	The following conditions must be satisfied to allow the device to operate forward: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled
Reverse I-Lock:	The following conditions must be satisfied to allow the device to operate reverse: • CON and local E-Stops not active • MMS-CNVM-103 rope switch not pulled

Table D.3. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MIN**

NOTE: The MIN will have a set of metering stops and an MCC verification station. Logic for these devices has not yet been developed, and will be added to the FAWB at a later date.

Device:	**MMS-GATE-101 Munition Access Blast Gate**
Advisor PC Tag:	M03HS135B
CONR:	TOCDF C101C
Driver Word:	1460
Driver Type:	8
Auto Open:	The auto open relay will be active if the following condition is satisfied: • "Open Blast Gate" output from the PDS sequencer (see sequencer tables) is active.
Auto Close:	The auto close relay will be active if the following condition is satisfied: • "Close Blast Gate" output from the PDS sequencer (see sequencer tables) is active.
Open I-Lock:	The following conditions must be satisfied to allow the device to open: • CON E-Stop not active • Mine System Local E-Stop not active • 03-XSH-127A (Explosion in ECR) not active • MMS-GATE-103 (DFS Feed Chute) closed • MMS-CNVM-103 Rope Switch not pulled • ECR 'HVAC Normal' (DICO from CONR-110) is active
Close I-Lock:	The following condition must be satisfied to allow the device to close: • Mine Swing Roller retracted (04-ZS-101A active)
Device:	**MHS-MIN-101 Mine Machine Input Conveyor**
Advisor PC Tag:	X44O1101
CONR:	TOCDF C101C
Driver Word:	1461
Driver Type:	12
Auto Forward:	The auto forward relay will be active if the following conditions are satisfied: • "Run Mine Machine Conveyor Forward" output from the PDS sequencer (see sequencer tables) is active. • "Mine Fail to Transfer to Input Conveyor" alarm is not active
Auto Reverse:	None.
Forward I-Lock:	The following conditions must be satisfied to allow the device to operate forward: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active • Mine is not present a feed metering stop (04-ZS-406 not active) or Mine Yoke Actuator at input position (44-1PLS-4-I active).

Table D.3. MHS PLC Automatic Control Sequences Advisor PC Screen: **MIN**	
Reverse I-Lock:	The following conditions must be satisfied to allow the device to operate reverse: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active
Device:	**MHS-MIN-101 Orientation Lift Table**
Advisor PC Tag:	X44O1102
CONR:	TOCDF C101C
Driver Word:	1462
Driver Type:	8
Auto Extend:	The auto extend relay will be active if the following condition is satisfied: • "Extend Orientation Lift Table" output from the PDS sequencer (see sequencer tables) is active.
Auto Retract:	The auto retract relay will be active if the following condition is satisfied: • "Retract Orientation Lift Table" output from the PDS sequencer (see sequencer tables) is active.
Extend I-Lock:	The following conditions must be satisfied to allow the device to extend: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active
Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active
Device:	**MHS-MIN-101 Orientation Motor**
Advisor PC Tag:	X44O1103
CONR:	CDTF C121C
Driver Word:	0263
Driver Type:	1
Auto Start:	The auto start relay will be active if the following conditions are satisfied: • "Run Orientation Motor" output from the PDS sequencer (see sequencer tables) is active or "MHS-MIN-101 Orientation Motor Run Forward Link" relay is active • Orientation motor extended-run timer is not expired

Start I-Lock:	The following conditions must be satisfied to allow the device to operate:
	• CON and local E-Stops not active
	• 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code)
	• Either of the following:
	  • Mine orientation station table raised (44-I1-102B)
	  • Metal mine not present in yoke (44-1PLS-1-I) and mine/MCC not present in yoke (44-1PLS-12-I)

Table D.3. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MIN**

Device:	**MHS-MIN-101 Yoke Stop**
Advisor PC Tag:	X44O1104
CONR:	TOCDF C101C
Driver Word:	1464
Driver Type:	11
Auto Open[1]:	The auto open relay will be active if the following condition is satisfied: • "Open Yoke Stop" output from the PDS sequencer (see sequencer tables) is active.
Auto Close[1]:	The auto close relay will be active if the following condition is satisfied: • "Close Yoke Stop" output from the PDS sequencer (see sequencer tables) is active.
Open[1] I-Lock:	The following conditions must be satisfied to allow the device to open: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active
Close[1] I-Lock:	The following conditions must be satisfied to allow the device to close: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active • Nonmetallic container is not in yoke

[1] The yoke stop is on a pivot. In the OPEN position, the hydraulic cylinder extends to move the stop out of the way of yoke rotation. In the CLOSE position, the hydraulic cylinder retracts to place the stop in position to stop the yoke in the vertical position.

Device:	**MHS-MIN-101 Mine Trolley**
Advisor PC Tag:	X44O1105
CONR:	CDTF C121C
Driver Word:	0265
Driver Type:	11
Auto Extend:	The auto extend relay will be active if the following condition is satisfied: • "Extend Trolley" output from the BPS sequencer (see sequencer tables) is active.
Auto Retract:	The auto retract relay will be active if the following condition is satisfied: • "Retract Trolley" output from the BPS sequencer (see sequencer tables) is active.
Extend I-Lock:	The following conditions must be satisfied to allow the device to extend: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code) • FARS spanner plate cylinder retracted (44-I1-106B) • "Mine in system and trolley ready waiting for punch" relay is not active or mine trolley is in AUTO

Table D.3. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MIN**

Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code)
Relay	The "Mine in system and trolley ready waiting for punch" relay is latched when the following conditions are satisfied: • Metal mine is present in yoke • Mine yoke is in the home position • Trolley is not in lockout (44-I1-PLS-11 not active) The "Mine in system and trolley ready waiting for punch" relay is unlatched when the following conditions are satisfied: • "Mine in system and trolley ready waiting for punch" relay is active • Mine drain punch cylinder is extended (44-I1-107A is active) • Mine system is initializing.
Device:	**MHS-MIN-101 FARS Spanner Plate**
Advisor PC Tag:	X44O1106
CONR:	CDTF C121C
Driver Word:	0266
Driver Type:	11
Auto Extend:	The auto extend relay will be active if the following conditions are satisfied: • "Extend Burster Punch[1]" output from the BPS[1] sequencer (see sequencer tables) is active. • FARS spanner plate cylinder is not extended (44-I1-106A is not active)
Auto Retract:	The auto retract relay will be active if the following condition is satisfied: • "Extend Burster Punch[1]" output from the BPS[1] sequencer (see sequencer tables) is active.
Extend I-Lock:	The following conditions must be satisfied to allow the device to extend: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code) • Mine not present at FARS (44-1PLS-9-I not active) or MMS-GATE-101 Munition Access Gate closed
Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code)

[1] The CDTF code still refers to the BPS the sequencer with outputs, "extend/retract burster punch," which refers to the original design configuration. With implementation of the FARS, the sequencer will be renamed the "FARS sequencer" and these outputs will be "extend/retract FARS spanner plate."

Table D.3. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MIN**

Device:	**MHS-MIN-101 Drain Punch Cylinder**
Advisor PC Tag:	X44O1107
CONR:	CDTF C121C
Driver Word:	0267
Driver Type:	11
Auto Extend:	The auto extend relay will be active if the following condition is satisfied: • "Extend Drain Punch" output from the PDS sequencer (see sequencer tables) is active.
Auto Retract:	The auto retract relay will be active if the following condition is satisfied: • "Retract Drain Punch" output from the PDS sequencer (see sequencer tables) is active.

Extend I-Lock:	The following conditions must be satisfied to allow the device to extend:
	• CON and local E-Stops not active
	• 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code)
	• Either of the following:
	  • Mine Yoke Rotator vertical (44-1PLS-5-I) and MHS-MIN-101 Drain Clamp Cylinder extended and MHS-MIN-101 Yoke Stop closed
	  • MHS-MIN-101 Drain Punch LMCP Permissive active

Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code)
Device:	**MHS-MIN-101 Drain Clamp Cylinder**
Advisor PC Tag:	X44O1108
CONR:	CDTF C121C
Driver Word:	0268
Driver Type:	11
Auto Extend:	The auto extend relay will be active if the following condition is satisfied: • "Extend Drain Clamp" output from the PDS sequencer (see sequencer tables) is active.
Auto Retract:	The auto retract relay will be active if the following condition is satisfied: • "Retract Drain Clamp" output from the PDS sequencer (see sequencer tables) is active.
Extend I-Lock:	The following conditions must be satisfied to allow the device to extend: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code) • Mine Yoke Rotator vertical (44-I1-PLS-5 active)

Table D.3. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MIN**

Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code) • Drain Punch Cylinder retracted (44-I1-107B active)
Device:	**MHS-MIN-101 Yoke Rotary Actuator**
Advisor PC Tag:	X44O1109
CONR:	CDTF C121C
Driver Word:	0269
Driver Type:	9
Auto Extend:	The auto extend relay will be active if the following condition is satisfied: • "Extend Yoke Drive to Discharge" output from the PDS sequencer (see sequencer tables) is active.
Auto Retract:	The auto retract relay will be active if the following condition is satisfied: • "Retract Yoke Drive to Input" output from the PDS sequencer (see sequencer tables) is active.
Extend I-Lock:	The following conditions must be satisfied to allow the device to extend: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code) • Drain Clamp Cylinder retracted (unclamped) (44-I1-108B active) or Yoke Rotator "Auto Extend" relay active • Drain Punch Cylinder retracted (44-I1-107B active) • Mine on trolley lockout (44-I1-PLS-1I) timer not expired
Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code) • Mine Orientation Station Cylinder lowered (44-I1-102A active) • Yoke Stop Open (44-I1-104A active) • Drain Clamp Cylinder retracted (unclamped) (44-I1-108B active) • Drain Punch Cylinder retracted (44-I1-107B active)
Device:	**ACS-PUMP-107 Agent Drain Pump (51-XV-753)**
Advisor PC Tag:	X51XV753
CONR:	CDTC C121C
Driver Word:	0270
Driver Type:	4

Table D.3. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MIN**

Auto Run:	The auto run relay will be active if the following conditions are satisfied: • Mine System is in AUTO. • "OK to run from ACS" DICO is active [will be DICO from ICS-CONR-106 at TOCDF]
Open I-Lock:	The following conditions must be satisfied to allow the device to open: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code) • "OK to run from ACS" DICO is active [will be DICO from ICS-CONR-106 at TOCDF]
Device:	**MMS-CNVM-103 Conveyor #2 Swing Roller[1]**
Advisor PC Tag:	X04HS518B
CONR:	C101C
Driver Word:	1471
Driver Type:	8
Auto Extend:	The auto extend relay will be active if the following condition is satisfied: • "Open Blast Gate" output from the PDS sequencer (see sequencer tables) is active.
Auto Retract:	The auto retract relay will be active if the following condition is satisfied: • "Close Blast Gate" output from the PDS sequencer (see sequencer tables) is active.
Extend I-Lock:	The following conditions must be satisfied to allow the device to extend: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active • MMS-GATE-101 Blast Gate open
Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active • MMS-CNVM-103 rope switch not pulled • Mine not present at Feed Stop (04-ZS-406)

[1] Swing roller logic is from the original TOCDF design. Since TOCDF will be using line B for mine processing, and line B was not originally equipped with a swing roller in the ECV, a swing roller will be added to the MIN input conveyor in ECR B. Revisions to the logic are expected because of this change.

Device:	**ACS-TANK-108 Level Isolation Valve (51-XV-755A)**
Advisor PC Tag:	X51XV755A
CONR:	CDTF C121C
Driver Word:	0272
Driver Type:	4

Table D.3. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MIN**

Auto Open:	The auto open relay will be active if either of the following conditions are satisfied: • "Open ACS-TANK-108 Level Isolation Valve" output from the PDS sequencer (see sequencer tables) is active and ACS-TANK-108 vacuum valve 51-XV-759B is closed (on 3-sec delay). • "AQS Tank Draining" timer done
Open I-Lock:	The following conditions must be satisfied to allow the device to open: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code) • ACS-TANK-108 vacuum valve 51-XV-759A is open or ACS-TANK-108 inlet valve 51-XV-757A is open • ACS-TANK-108 level purge valve 51-XV-756 is not open
Device:	**ACS-TANK-108 Level Purge Valve (51-XV-756)**
Advisor PC Tag:	X51XV756
CONR:	CDTF C121C
Driver Word:	0273
Driver Type:	4
Auto Open:	The auto open relay will be active if any of the following conditions are satisfied: • "AQS Tank Draining" timer is enabled and the timer value is less than 2 seconds. • "AQS Tank Inlet Valve Open for Purge" timer is active. • "AQS Tank Level Valve Pre-Purge" timer is enabled.

Open I-Lock:	The following conditions must be satisfied to allow the device to open:
	• CON and local E-Stops not active
	• 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code)
	• ACS-TANK-108 level isolation valve 51-XV-755A is not open
	• Any of the following:
	  • ACS-TANK-108 inlet valve 51-XV-757 is open
	  • ACS-TANK-108 vacuum valve 51-XV-759 is open
	  • ACS-TANK-108 drain valve 51-XV-758 is open

Device:	**ACS-TANK-108 Inlet Valve (51-XV-757)**
Advisor PC Tag:	X51XV757
CONR:	CDTF C121C
Driver Word:	0274
Driver Type:	4
Auto Open:	The auto open relay will be active if the following condition is satisfied: • "Open ACS-TANK-108 Inlet Valve" output from the PDS sequencer (see sequencer tables) is active

Table D.3. MHS PLC Automatic Control Sequences Advisor PC Screen: **MIN**	
Open I-Lock:	The following conditions must be satisfied to allow the device to open: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code)
Device:	**ACS-TANK-108 Drain Valve (51-XV-758)**
Advisor PC Tag:	X51XV758
CONR:	CDTF C121C
Driver Word:	0275
Driver Type:	4
Auto Open:	The auto open relay will be active if either of the following conditions are satisfied: • "ACS-TANK-108 Draining Tank to Start" output from the PDS sequencer (see sequencer tables) is active (on 2-sec delay) and "AQS Tank Draining" timer is not done. • Punch & Drain Station is initializing
Open I-Lock:	The following conditions must be satisfied to allow the device to open: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code)
Device:	**ACS-TANK-108 Vacuum Valve (51-XV-759)**
Advisor PC Tag:	X51XV759
CONR:	CDTF C121C
Driver Word:	0276
Driver Type:	4
Auto Open:	The auto open relay will be active if the following condition is satisfied: • "Open ACS-TANK-108 Vacuum Valve" output from the PDS sequencer (see sequencer tables) is active
Open I-Lock:	The following conditions must be satisfied to allow the device to open: • CON and local E-Stops not active • 03-XSH-127A (Explosion in ECR) not active (input not in CDTF code but will be in TOCDF code)
Device:	**Arming Plug Extractor Feed Stop[1] (51-XY-415)**
Advisor PC Tag:	X44XY415
CONR:	CDTF C121C
Driver Word:	0291
Driver Type:	8
Auto Extend:	The auto extend relay will be active if either of the following conditions is satisfied: • Arming plug extractor is not running in AUTO • Arming plug extractor is running in AUTO and mine is not at APE discharge stop (44-ZS-419 not active) (on 3-sec delay) or arming plug extractor ejector is extended

Table D.3. MHS PLC Automatic Control Sequences
Advisor PC Screen: **MIN**

Auto Retract:	The auto retract relay will be active if the following condition is satisfied: • Arming plug extractor "AUTO EXTEND" relay is not active
Extend I-Lock:	The following condition must be satisfied to allow the device to extend: • CON and local E-Stops not active
Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • Mine in APE at discharge stop (44-I1-419 active) • APE discharge stop raised (44-ZS-416A active)

[1] Even though the APE will not be used at CONUS sites, the feed stops will be used in the ECR for the MCC verification station (see FAWB Notes B-23 and B-24). The device name and the logic will be modified to remove reference to the APE.

Device:	**Arming Plug Extractor Discharge Stop[1] (51-XY-416)**
Advisor PC Tag:	X44XY416
CONR:	CDTF C121C
Driver Word:	0292
Driver Type:	8
Auto Extend:	The auto extend relay will be active if the following condition is satisfied: • "APE Discharge Stop Up" output from the PDS sequencer (see sequencer tables) is active
Auto Retract:	The auto retract relay will be active if the following condition is satisfied: • "APE Discharge Stop Down" output from the PDS sequencer (see sequencer tables) is active
Extend I-Lock:	The following condition must be satisfied to allow the device to extend: • CON and local E-Stops not active • Arming plug extractor arm extended (up) (44-ZS-417A active)
Retract I-Lock:	The following conditions must be satisfied to allow the device to retract: • CON and local E-Stops not active • Mine/MCC not in Yoke (PLS-12 not active) • APE feed stop raised (44-ZS-415A active) • Arming plug extractor arm extended (up) (44-ZS-417A active)

[1] Even though the APE will not be used at CONUS sites, the feed stops will be used in the ECR for the MCC verification station (see FAWB Notes B-23 and B-24). The device name and the logic will be modified to remove reference to the APE.

Table D.4. TOCDF MHS PLC Automatic Control Sequences
Advisor PC Screen: **MNI**

Device:	**Mine System Initialize Icon**
Advisor PC Tag:	MHSYSINIT
CONR:	C101C
Driver Word:	1280
Driver Type:	N/A
	The control room operator selects this icon and issues a manual start command to initialize the Mine System.
Device:	**Mine System Start Icon**
Advisor PC Tag:	MHSYSRUN
CONR:	C101C
Driver Word:	1281
Driver Type:	N/A
	The control room operator selects this icon and issues a manual start command to place the Mine System in “Auto Run”.
Device:	**Mine Metering Machine Initialize Icon**
Advisor PC Tag:	MMMACINIT
CONR:	C101C
Driver Word:	1282
Driver Type:	N/A
	The control room operator selects this icon and issues a manual start command to initialize the Mine Metering Machine.
Device:	**Mine System Park Icon**
Advisor PC Tag:	MHSYSPARK
CONR:	C101C
Driver Word:	1482
Driver Type:	N/A
	The control room operator selects this icon and issues a manual start command to park the Mine System.
Device:	**Punch and Drain Station Initialize Icon**
Advisor PC Tag:	PDSTAINIT
CONR:	C101C
Driver Word:	1483
Driver Type:	N/A
	The control room operator selects this icon and issues a manual start command to initialize the Punch & Drain Station.
Device:	**Burster Punch Station Initialize Icon**
Advisor PC Tag:	BPSTAINIT
CONR:	C101C
Driver Word:	1484
Driver Type:	N/A

Table D.4. TOCDF MHS PLC Automatic Control Sequences
Advisor PC Screen: **MNI**

	The control room operator selects this icon and issues a manual start command to initialize the Burster Punch Station.
Device:	**Punch and Drain Station Mode Icon**
Advisor PC Tag:	PDSTAMODE
CONR:	C101C
Driver Word:	1487
Driver Type:	N/A
	The control room operator selects this icon and issues a 'manual' or 'auto' command to change the mode of the Punch & Drain Station sequencer.
Device:	**Burster Punch Station Mode Icon**
Advisor PC Tag:	BPSTAMODE
CONR:	C101C
Driver Word:	1488
Driver Type:	N/A
	The control room operator selects this icon and issues a 'manual' or 'auto' command to change the mode of the Burster Punch Station sequencer.
Device:	**Punch and Drain Station Bypass/Repeat Step Icon**
Advisor PC Tag:	PDSTABPRS
CONR:	C101C
Driver Word:	1489
Driver Type:	N/A
	The control room operator selects this icon and issues a REPEAT command to repeat a sequencer step or a BYPASS command to bypass a step of the Punch & Drain Station sequencer. Refer to the sequencer tables to determine which sequencer steps can be bypassed or repeated.
Device:	**Burster Punch Station Bypass/Repeat Step Icon**
Advisor PC Tag:	BPSTABPRS
CONR:	C101C
Driver Word:	1490
Driver Type:	N/A
	The control room operator selects this icon and issues a REPEAT command to repeat a sequencer step or a BYPASS command to bypass a step of the Burster Punch Station sequencer. Refer to the sequencer tables to determine which sequencer steps can be bypassed or repeated.

D.2 MHS Sequencer Tables

Sequencers are used throughout chemical demilitarization facilities to perform sequenced machine control. A sequence is a series of steps that a machine performs to accomplish a task. One or more actions are required to perform each step. The step is complete when the desired results are met. Sequencers are used to control the PDS and FARS operations in the MHS. The PDS sequencer tables refer to the APE station, which will not be used at CONUS sites (see FAWB Notes B-23 and B-24).

When a sequencer advances to a step, up to 32 bits of output control information are generated to produce a desired set of actions. The sequencer monitors up to 32 bits of status input data and remains at that step until all the desired results are met. Once a step is complete, the sequencer advances to the next step. This continues until the task that the sequencer controls is complete. When the task is complete, the sequencer resets itself back to the beginning (usually step 1.1).

The design of the CSD PLC-3 sequencer uses five sets of data and two counters. The data sets are defined as follows:

1. Actual Input - Up to 32 discrete status indications can be defined for each sequencer. They can be inputs from the field (proximity switch, pressure switch, etc.) or internally generated relays (level indication > 17.0 in. wc.). Once defined, these 32 bits have the same meaning for each step in the sequencer. For example, if bit 1 is defined as “Stop Clamp Retracted”, then that is the definition of bit 1 for all of the sequencer steps. On every scan of the PLC-3 application code, these 32 data points are packed into one contiguous area of memory to be compared to the Input Comparison data for the sequencer step.

2. Input Comparison - The Input Comparison data are stored in the PLC-3 memory, one 32-bit set for each step. For a sequencer step to be complete, the Actual Input data and the Input Comparison data must be equal when filtered through the Normal Mask data set for the step.

3. Normal Mask - The Normal Mask data are stored in the PLC-3 memory, one 32-bit set for each set. The Normal Mask is used during normal, vice bypass mode, operation. Not all Actual Input data are meaningful at every step of the sequence. The Normal Mask allows the sequencer to ignore the status of a particular input while testing for completion of a step. For example, at RDS sequencer step 2.2 “Extend Bottom Clamp”, we “don’t care” if the RSM is in a shear cycle. Therefore, bit 15 of word 2 of the normal mask for step 2.2 is a zero or “don’t care.” Now when the Actual Input is moved through the Normal Mask, the result will be a zero for bit 15 so that when the result and the Input Comparison data are compared, step 2.2 can be completed whether bit 15 of word 2 is set or not.

4. Bypass Mask - The Bypass Mask works just like the Normal Mask except it is only used when the operator bypasses a sequencer step. For example, step 5.3 of the RDS sequencer is where the rocket is drained. To complete step 5.3 under normal conditions the AQS system must indicate that a good drain has occurred. If, after repeated drain attempts, the AQS system fails to provide a good drain indication, the operator can bypass the step and force the sequencer to step 5.4. Not all steps can be bypassed. For bypass to be enabled, bit 14 of Output word 2 must be set for the step that is to be bypassed.

5. Output - The Output data are stored in the PLC-3 memory, one 32-bit set for each step. When a sequencer advances to a step, up to 32 bits of output control information are generated to produce a desired set of actions. This data is generally used in the logic that energizes the automatic action relays for the sequenced machine components. Bits 14-17 of Output word 2 have special functions as follows:

   14 - Bit 14 is set if the step can be bypassed.
   15 - Bit 15 is set if the step can be repeated.
   16 - Bit 16 is set if the step is the last Minor Step in the current Major Step.
   17 - Bit 17 is set if the step is the last step in the sequencer.

The sequencer step status is maintained by two counters. One counter is for the Major Step, the other is for the Minor Step. For example, step 7.2 is Major Step 7 and Minor Step 2. A Major Step reflects a complete task. A Minor Step is one of the tasks required to complete a Major Step. For example, RDS Major Step 7 will rotate the rocket. The Minor Steps to rotate the rocket are: 1) raise the lift table, 2) actuate the rotator, 3) lower the lift table, and 4) home the rotator. When a step is complete (i.e., Actual Inputs match the Input Comparisons) the Minor Step counter increments. If the step was the last Minor Step in the Major Step (Output word 2, bit 16 set), the Minor Step counter is reset to zero and the Major Step counter is incremented. If the step was the last Minor Step in the sequencer (Output word 2, bit 17), the Major Step counter is set to the initial step for the campaign (usually 1) and the Minor Step counter is set to 1.

Repeat. Some steps, such as RDS step 5.3 “rocket drain verification”, can be repeated. For these steps, Output word 2, bit 15 is set as a permissive. When the operator requests that a step be repeated, the Major Step is decremented and the Minor Step is reset to zero. In the case of the rocket drain, the sequencer would reset to step 4.0 to punch and drain the rocket a second time. The sequencer goes to manual when the repeat command is issued and must be returned to automatic to resume normal operation.

Manual Stepping. The operator can manually step through the sequencer. To do this the sequencer must be in manual. Once the machine status and the desired status are equal for a step, the operator can request a manual step. The sequencer will increment to the next step and issue new Output data and access new Input Comparison data.

Reset. The operator can reset the sequencer at any time. When the sequencer resets, the Major Step counter for the sequencer is set to the initial step for the campaign (usually 1). The Minor Step counter is reset to zero, the sequencer goes from automatic to manual, and the Input Comparison data for the initial step for the campaign becomes the desired status for completion of the step. Because the machine can be in any combination of states, the operator must take manual action to match the Actual Input data to the Input Comparison data using the View Sequencer display on the Advisor. Once the machine status and the desired status are equal, the operator can place the sequencer back into automatic and processing will resume starting with Minor Step 1 of the initial Major Step.

View Sequencer. The operator can determine the status of a sequencer step by accessing the View Sequencer information on the Advisor control screen for the sequencer. The View Sequencer feature displays the Actual Input data from the machine and the Input Comparison data for the sequencer step. Any mismatches are highlighted to provide the operator with immediate feedback as to what actions must be taken to complete the sequencer step.

Initialize. During initialization, the Major Step counter for the sequencer is set to the initial step for the campaign (usually 1). The Minor Step counter is reset to zero.

Park. During System Park, the sequencer is set to step 0.1. When the Actual Input data and the Input Comparison data are equal, the sequencer is reset to step 0.0.

Raytheon Engineers and Constructors - CDTF Job #9338900 September-17-02

MINE Punch & Drain File Name: PDS_APE.XLS Cntl - CTC121C C71 - Major Step Counter

Pointer Number: 11 Datatable Word (1 or 2) = **1** REV - 7 C71 - Minor Step Location

Mine Line with APE **INPUT COMPARISON** File = B11 : 0 N100 - Display Location

17- MINE OR CONTAINER IN YOKE
16- LIFT TABLE ROTATING
15- MINE MACH READY TO SEND MINE
14- YOKE STOP CLOSED
13- YOKE STOP OPEN
12- LIFT TABLE EXTENDED
11- LIFT TABLE RETRACTED
10- YOKE IN DISCHARGE POS
07- YOKE IN HOME POS
06- YOKE IN VERTICLE POS
05- BURSTER WELL ORIENTATED
04- MINE HANDLE ORIENTATED
03- MINE IN YOKE (METAL)
02- MINE LEAVING APE
01- APE DISCHARGE STOP RAISED
00- APE DISCHARGE STOP LOWERED

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:10	HEX VALUE	STEP DESCRIPTION
STEP																	WORD ADRS		
0.0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	B11 :0	0A80	P&D STATION PARKED AND OFF
0.1	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	0	B11 :1	0A80	PARK P&D STATION
1.0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	B11 :10	0A82	INITIALIZE P&D STATION
1.1	0	0	1	0	1	0	1	0	1	0	0	0	0	0	1	0	B11 :11	2A82	WAITING FOR FEED SYSTEM
1.2	0	0	0	0	1	0	1	0	1	0	0	0	0	0	0	1	B11 :12	0A81	LOWER APE DISCHRG STOP
1.3	0	0	0	0	1	0	1	0	1	0	0	0	0	1	0	1	B11 :13	0A85	START CONV & SEND MINE
1.4	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	B11 :14	0A82	RAISE APE STOP & CYCLE EJECTR
2.0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	B11 :20	0A82	INITIALIZE STEP
2.1	1	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	B11 :21	8A82	MINE OR CONTAINER IN YOKE
2.2	1	0	0	0	1	0	1	0	1	0	0	0	1	0	1	0	B11 :22	8A8A	TIME DELAY
2.3	1	0	0	0	1	0	1	0	1	0	0	0	1	0	1	0	B11 :23	8A8A	STOP CONVEYOR
3.0	1	0	0	0	1	0	1	0	1	0	0	0	1	0	1	0	B11 :30	8A8A	INITIALIZE STEP
3.1	0	0	0	0	1	1	0	0	1	0	0	0	0	0	1	0	B11 :31	0C82	EXTEND LIFT TABLE
3.2	0	1	0	0	1	1	0	0	1	0	1	1	0	0	1	0	B11 :32	4CB2	ROTATE LIFT TABLE
3.3	0	0	0	0	1	1	0	0	1	0	1	1	0	0	1	0	B11 :33	0CB2	TIME DELAY
3.4	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	B11 :34	0A82	RETRACT LIFT TABLE
4.0	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	B11 :40	0A82	INITIALIZE STEP
4.1	0	0	0	1	0	0	1	0	1	0	0	0	0	0	1	0	B11 :41	1282	RTRCT YOKE STP CLY-IF METAL MINE
4.2	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	B11 :42	1242	ROTATE YOKE TO VERTICAL
4.3	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	B11 :43	1242	EXTEND CLAMP
4.4	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	B11 :44	1242	EXTEND PUNCH
5.0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	B11 :50	1242	INITIALIZE STEP
5.1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	B11 :51	1242	OPEN INLET VALVE 757
5.2	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	B11 :52	1242	CLOSE VACUUM VALVE 759
5.3	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	B11 :53	1242	OPEN ISO VALVE + CHECK DRAIN
5.4	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	B11 :54	1242	OPEN DRAIN VALVE 758
6.0	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	B11 :60	1242	INITIALIZE STEP
6.1	0	0	0	1	0	0	1	0	0	1	0	0	0	0	1	0	B11 :61	1242	RETRACT PUNCH
6.2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	B11 :62	0A02	RTRCT CLMP,YOKE DRV OFF,EXT STOP
7.0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	B11 :70	0A02	INITIALIZE STEP
7.1	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	0	B11 :71	0B02	ROTATE YOKE TO DISCHARGE
7.2	0	0	0	0	1	0	1	1	0	0	0	0	0	0	1	0	B11 :72	0B02	TROLLEY TAKE MINE
7.3	0	0	0	0	1	0	1	0	1	0	0	0	0	0	1	0	B11 :73	0A82	ROTATE YOKE TO INPUT

Raytheon Engineers and Constructors - CDTF Job #9338900 September-17-02

MINE Punch & Drain File Name: PDS_APE.XLS Cntl - CTC121C C71 - Major Step Counter

Pointer Number: 11 Datatable Word (1 or 2) = **2** REV - 7 C71 - Minor Step Location

Mine Line with APE **INPUT COMPARISON** File = B11 : 200 N100 - Display Location

17- EJECTOR HAS CYCLED
16- VACUUM VALVE CLOSED
15- AQS COMPLETE - GOOD DRAIN ???
14- AQS TANK READY
13- INLET VALVE CLOSED
12- MINE MACH INPUT CONV RUNNING FRWD
11- OUTPUT TO YOKE DRIVE
10- PDS TIME DELAY COMPLETE
07- MINE DRAINED (TIMER T108)
06- TROLLEY AT MIDDLE POSITION
05- MINE ON TROLLEY LOCKOUT
04- TROLLEY IN HOME POSITION
03- DRAIN CLAMP RETRACTED
02- DRAIN CLAMP EXTENDED (CLAMPED)
01- DRAIN PUNCH RETRACTED
00- DRAIN PUNCH EXTENDED

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:11 WORD ADRS	HEX VALUE	STEP DESCRIPTION
STEP																			
0.0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	B11 :200	000A	P&D STATION PARKED AND OFF
0.1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	B11 :201	000A	PARK P&D STATION
1.0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	B11 :210	000A	INITIALIZE P&D STATION
1.1	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	0	B11 :211	100A	WAITING FOR FEED SYSTEM
1.2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	B11 :212	000A	LOWER APE DISCHRG STOP
1.3	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	B11 :213	040A	START CONV & SEND MINE
1.4	1	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	B11 :214	840A	RAISE APE STOP & CYCLE EJECTR
2.0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	B11 :220	040A	INITIALIZE STEP
2.1	0	0	0	0	0	1	0	0	0	0	0	0	1	0	1	0	B11 :221	040A	MINE OR CONTAINER IN YOKE
2.2	0	0	0	0	0	1	0	1	0	0	0	0	1	0	1	0	B11 :222	050A	TIME DELAY
2.3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	B11 :223	000A	STOP CONVEYOR
3.0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	B11 :230	000A	INITIALIZE STEP
3.1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	B11 :231	080A	EXTEND LIFT TABLE
3.2	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	B11 :232	080A	ROTATE LIFT TABLE
3.3	0	0	0	0	1	0	0	1	0	0	0	0	1	0	1	0	B11 :233	090A	TIME DELAY
3.4	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	B11 :234	080A	RETRACT LIFT TABLE
4.0	0	0	0	0	1	1	0	0	0	0	0	0	1	0	1	0	B11 :240	0C0A	INITIALIZE STEP
4.1	0	0	0	0	1	0	0	0	0	0	0	0	1	0	1	0	B11 :241	080A	RTRCT YOKE STP CLY-IF METAL MINE
4.2	0	0	0	0	1	0	1	0	0	0	0	0	1	0	1	0	B11 :242	0A0A	ROTATE YOKE TO VERTICAL
4.3	0	0	0	0	1	0	1	0	0	0	0	0	0	1	1	0	B11 :243	0A06	EXTEND CLAMP
4.4	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	B11 :244	0805	EXTEND PUNCH
5.0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	1	B11 :250	0805	INITIALIZE STEP
5.1	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	B11 :251	0085	OPEN INLET VALVE 757
5.2	0	1	0	0	0	0	0	0	1	0	0	0	0	1	0	1	B11 :252	4085	CLOSE VACUUM VALVE 759
5.3	0	1	1	0	0	0	0	0	1	0	0	0	0	1	0	1	B11 :253	6085	OPEN ISO VALVE + CHECK DRAIN
5.4	0	1	0	1	0	0	0	0	1	0	0	0	0	1	0	1	B11 :254	5085	OPEN DRAIN VALVE 758
6.0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	1	B11 :260	0085	INITIALIZE STEP
6.1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	B11 :261	0006	RETRACT PUNCH
6.2	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	B11 :262	001A	RTRCT CLMP,YOKE DRV OFF,EXT STOP
7.0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	1	0	B11 :270	001A	INITIALIZE STEP
7.1	0	0	0	0	0	0	1	0	0	0	0	1	1	0	1	0	B11 :271	021A	ROTATE YOKE TO DISCHARGE
7.2	0	0	0	0	0	0	0	0	0	1	0	0	1	0	1	0	B11 :272	004A	TROLLEY TAKE MINE
7.3	0	0	0	0	0	0	1	0	0	0	0	0	1	0	1	0	B11 :273	020A	ROTATE YOKE TO INPUT

Raytheon Engineers and Constructors - CDTF Job #9338900 September-17-02

MINE Punch & Drain File Name: PDS_APE.XLS Cntl - CTC121C C71 - Major Step Counter

Pointer Number: 12 Datatable Word (1 or 2) = **1** REV - 7 C71 - Minor Step Location

Mine Line with APE **NORMAL MASK** File = B11 : 400 N100 - Display Location

17- MINE OR CONTAINER IN YOKE
16- LIFT TABLE ROTATING
15- MINE MACH READY TO SEND MINE
14- YOKE STOP CLOSED
13- YOKE STOP OPEN
12- LIFT TABLE EXTENDED
11- LIFT TABLE RETRACTED
10- YOKE IN DISCHARGE POS
07- YOKE IN HOME POS
06- YOKE IN VERTICLE POS
05- BURSTER WELL ORIENTATED
04- MINE HANDLE ORIENTATED
03- MINE IN YOKE (METAL)
02- MINE LEAVING APE
01- APE DISCHARGE STOP RAISED
00- APE DISCHARGE STOP LOWERED

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:10		
STEP																	WORD ADRS	**HEX VALUE**	**STEP DESCRIPTION**
0.0	1	1	0	1	1	1	1	1	1	1	0	0	1	0	0	0	B11 :400	DFC8	P&D STATION PARKED AND OFF
0.1	1	1	0	1	1	1	1	1	1	1	0	0	1	0	0	0	B11 :401	DFC8	PARK P&D STATION
1.0	1	1	0	1	1	1	1	1	1	1	0	0	1	0	1	1	B11 :410	DFCB	INITIALIZE P&D STATION
1.1	1	1	1	1	1	1	1	1	1	1	0	0	1	0	1	1	B11 :411	FFCB	WAITING FOR FEED SYSTEM
1.2	1	1	0	1	1	1	1	1	1	1	0	0	1	0	1	1	B11 :412	DFCB	LOWER APE DISCHRG STOP
1.3	1	1	0	1	1	1	1	1	1	1	0	0	0	1	1	1	B11 :413	DFC7	START CONV & SEND MINE
1.4	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :414	5FC3	RAISE APE STOP & CYCLE EJECTR
2.0	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :420	5FC3	INITIALIZE STEP
2.1	1	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :421	DFC3	MINE OR CONTAINER IN YOKE
2.2	1	1	0	1	1	1	1	1	1	1	0	0	1	0	1	1	B11 :422	DFCB	TIME DELAY
2.3	1	1	0	1	1	1	1	1	1	1	0	0	1	0	1	1	B11 :423	DFCB	STOP CONVEYOR
3.0	1	1	0	1	1	1	1	1	1	1	0	0	1	0	1	1	B11 :430	DFCB	INITIALIZE STEP
3.1	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :431	5FC3	EXTEND LIFT TABLE
3.2	0	1	0	1	1	1	1	1	1	1	1	1	0	0	1	1	B11 :432	5FF3	ROTATE LIFT TABLE
3.3	0	1	0	1	1	1	1	1	1	1	1	1	0	0	1	1	B11 :433	5FF3	TIME DELAY
3.4	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :434	5FC3	RETRACT LIFT TABLE
4.0	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :440	5FC3	INITIALIZE STEP
4.1	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :441	5FC3	RTRCT YOKE STP CLY-IF METAL MINE
4.2	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :442	5FC3	ROTATE YOKE TO VERTICAL
4.3	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :443	5FC3	EXTEND CLAMP
4.4	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :444	5FC3	EXTEND PUNCH
5.0	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :450	5FC3	INITIALIZE STEP
5.1	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :451	5FC3	OPEN INLET VALVE 757
5.2	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :452	5FC3	CLOSE VACUUM VALVE 759
5.3	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :453	5FC3	OPEN ISO VALVE + CHECK DRAIN
5.4	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :454	5FC3	OPEN DRAIN VALVE 758
6.0	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :460	5FC3	INITIALIZE STEP
6.1	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :461	5FC3	RETRACT PUNCH
6.2	0	1	0	1	1	1	1	1	1	0	0	0	0	0	1	1	B11 :462	5F83	RTRCT CLMP,YOKE DRV OFF,EXT STOP
7.0	0	1	0	1	1	1	1	1	0	1	0	0	0	0	1	1	B11 :470	5F43	INITIALIZE STEP
7.1	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :471	5FC3	ROTATE YOKE TO DISCHARGE
7.2	0	1	0	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :472	5FC3	TROLLEY TAKE MINE
7.3	0	1	1	1	1	1	1	1	1	1	0	0	0	0	1	1	B11 :473	7FC3	ROTATE YOKE TO INPUT

Raytheon Engineers and Constructors - CDTF Job #9338900 September-17-02

MINE Punch & Drain File Name: PDS_APE.XLS Cntl - CTC121C C71 - Major Step Counter

Pointer Number: 12 Datatable Word (1 or 2) = **2** REV - 7 C71 - Minor Step Location

Mine Line with APE **NORMAL MASK** File = B11 : 600 N100 - Display Location

17- EJECTOR HAS CYCLED
16- VACUUM VALVE CLOSED
15- AQS COMPLETE - GOOD DRAIN ???
14- AQS TANK READY
13- INLET VALVE CLOSED
12- MINE MACH INPUT CONV RUNNING FRWD
11- OUTPUT TO YOKE DRIVE
10- PDS TIME DELAY COMPLETE
07- MINE DRAINED (TIMER T108)
06- TROLLEY AT MIDDLE POSITION
05- MINE ON TROLLEY LOCKOUT
04- TROLLEY IN HOME POSITION
03- DRAIN CLAMP RETRACTED
02- DRAIN CLAMP EXTENDED (CLAMPED)
01- DRAIN PUNCH RETRACTED
00- DRAIN PUNCH EXTENDED

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:11	HEX VALUE	STEP DESCRIPTION
STEP																	WORD ADRS		
0.0	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	1	B11 :600	018F	P&D STATION PARKED AND OFF
0.1	0	0	0	0	0	0	0	1	1	0	0	0	1	1	1	1	B11 :601	018F	PARK P&D STATION
1.0	0	0	0	0	0	0	0	1	1	0	1	0	1	1	1	1	B11 :610	01AF	INITIALIZE P&D STATION
1.1	0	0	0	1	0	0	1	1	1	0	1	0	1	1	1	1	B11 :611	13AF	WAITING FOR FEED SYSTEM
1.2	0	0	0	0	0	0	1	1	1	0	1	0	1	1	1	1	B11 :612	03AF	LOWER APE DISCHRG STOP
1.3	0	0	0	0	0	1	1	1	1	0	1	0	1	1	1	1	B11 :613	07AF	START CONV & SEND MINE
1.4	1	0	0	0	0	1	1	1	1	0	1	0	1	1	1	1	B11 :614	87AF	RAISE APE STOP & CYCLE EJECTR
2.0	0	0	0	0	0	1	1	1	1	0	1	0	1	1	1	1	B11 :620	07AF	INITIALIZE STEP
2.1	0	0	0	0	0	1	1	1	1	0	1	0	1	1	1	1	B11 :621	07AF	MINE OR CONTAINER IN YOKE
2.2	0	0	0	0	0	1	1	1	1	0	1	0	1	1	1	1	B11 :622	07AF	TIME DELAY
2.3	0	0	0	0	0	0	1	1	1	0	1	0	1	1	1	1	B11 :623	03AF	STOP CONVEYOR
3.0	0	0	0	0	0	0	1	1	1	0	1	0	1	1	1	1	B11 :630	03AF	INITIALIZE STEP
3.1	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :631	0BAF	EXTEND LIFT TABLE
3.2	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :632	0BAF	ROTATE LIFT TABLE
3.3	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :633	0BAF	TIME DELAY
3.4	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :634	0BAF	RETRACT LIFT TABLE
4.0	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :640	0BAF	INITIALIZE STEP
4.1	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :641	0BAF	RTRCT YOKE STP CLY-IF METAL MINE
4.2	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :642	0BAF	ROTATE YOKE TO VERTICAL
4.3	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :643	0BAF	EXTEND CLAMP
4.4	0	0	0	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :644	0BAF	EXTEND PUNCH
5.0	0	1	1	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :650	6BAF	INITIALIZE STEP
5.1	0	1	1	0	1	0	1	1	1	0	1	0	1	1	1	1	B11 :651	6BAF	OPEN INLET VALVE 757
5.2	0	1	1	0	0	0	1	1	1	0	1	0	1	1	1	1	B11 :652	63AF	CLOSE VACUUM VALVE 759
5.3	0	1	1	0	0	0	1	1	1	0	1	0	1	1	1	1	B11 :653	63AF	OPEN ISO VALVE + CHECK DRAIN
5.4	0	1	1	1	0	0	1	1	1	0	1	0	1	1	1	1	B11 :654	73AF	OPEN DRAIN VALVE 758
6.0	0	0	0	0	0	0	1	1	1	0	1	0	1	1	1	1	B11 :660	03AF	INITIALIZE STEP
6.1	0	0	0	0	0	0	1	1	1	0	1	0	1	1	1	1	B11 :661	03AF	RETRACT PUNCH
6.2	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	B11 :662	03FF	RTRCT CLMP,YOKE DRV OFF,EXT STOP
7.0	0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	B11 :670	03FF	INITIALIZE STEP
7.1	0	0	0	0	0	0	1	1	1	1	0	1	1	1	1	1	B11 :671	03DF	ROTATE YOKE TO DISCHARGE
7.2	0	0	0	0	0	0	1	1	1	1	0	0	1	1	1	1	B11 :672	03CF	TROLLEY TAKE MINE
7.3	0	0	0	0	0	0	1	1	1	0	1	0	1	1	1	1	B11 :673	03AF	ROTATE YOKE TO INPUT

Raytheon Engineers and Constructors - CDTF Job #9338900 September-17-02

MINE Punch & Drain File Name: PDS_APE.XLS Cntl - CTC121C C71 - Major Step Counter

Pointer Number: 13 Datatable Word (1 or 2) = **1** REV - 7 C71 - Minor Step Location

Mine Line with APE **BYPASS MASK** File = B11 : 800 N100 - Display Location

17- MINE OR CONTAINER IN YOKE
16- LIFT TABLE ROTATING
15- MINE MACH READY TO SEND MINE
14- YOKE STOP CLOSED
13- YOKE STOP OPEN
12- LIFT TABLE EXTENDED
11- LIFT TABLE RETRACTED
10- YOKE IN DISCHARGE POS
07- YOKE IN HOME POS
06- YOKE IN VERTICLE POS
05- BURSTER WELL ORIENTATED
04- MINE HANDLE ORIENTATED
03- MINE IN YOKE (METAL)
02- MINE LEAVING APE
01- APE DISCHARGE STOP RAISED
00- APE DISCHARGE STOP LOWERED

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:10	HEX VALUE	STEP DESCRIPTION
STEP																	WORD ADRS		
0.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :800	FFFF	P&D STATION PARKED AND OFF
0.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :801	FFFF	PARK P&D STATION
1.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :810	FFFF	INITIALIZE P&D STATION
1.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :811	FFFF	WAITING FOR FEED SYSTEM
1.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :812	FFFF	LOWER APE DISCHRG STOP
1.3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :813	FFFF	START CONV & SEND MINE
1.4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :814	FFFF	RAISE APE STOP & CYCLE EJECTR
2.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :820	FFFF	INITIALIZE STEP
2.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :821	FFFF	MINE OR CONTAINER IN YOKE
2.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :822	FFFF	TIME DELAY
2.3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :823	FFFF	STOP CONVEYOR
3.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :830	FFFF	INITIALIZE STEP
3.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :831	FFFF	EXTEND LIFT TABLE
3.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :832	FFFF	ROTATE LIFT TABLE
3.3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :833	FFFF	TIME DELAY
3.4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :834	FFFF	RETRACT LIFT TABLE
4.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :840	FFFF	INITIALIZE STEP
4.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :841	FFFF	RTRCT YOKE STP CLY-IF METAL MINE
4.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :842	FFFF	ROTATE YOKE TO VERTICAL
4.3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :843	FFFF	EXTEND CLAMP
4.4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :844	FFFF	EXTEND PUNCH
5.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :850	FFFF	INITIALIZE STEP
5.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :851	FFFF	OPEN INLET VALVE 757
5.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :852	FFFF	CLOSE VACUUM VALVE 759
5.3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :853	FFFF	OPEN ISO VALVE + CHECK DRAIN
5.4	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :854	FFFF	OPEN DRAIN VALVE 758
6.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :860	FFFF	INITIALIZE STEP
6.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :861	FFFF	RETRACT PUNCH
6.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :862	FFFF	RTRCT CLMP,YOKE DRV OFF,EXT STOP
7.0	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :870	FFFF	INITIALIZE STEP
7.1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :871	FFFF	ROTATE YOKE TO DISCHARGE
7.2	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :872	FFFF	TROLLEY TAKE MINE
7.3	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	B11 :873	FFFF	ROTATE YOKE TO INPUT

Raytheon Engineers and Constructors - CDTF Job #9338900 September-17-02

MINE Punch & Drain File Name: PDS_APE.XLS Cntl - CTC121C C71 - Major Step Counter

Pointer Number: 13 Datatable Word (1 or 2) = **2** REV - 7 C71 - Minor Step Location

Mine Line with APE **BYPASS MASK** File = B11 : 1000 N100 - Display Location

17- EJECTOR HAS CYCLED
16- VACUUM VALVE CLOSED
15- AQS COMPLETE - GOOD DRAIN ???
14- AQS TANK READY
13- INLET VALVE CLOSED
12- MINE MACH INPUT CONV RUNNING FRWD
11- OUTPUT TO YOKE DRIVE
10- PDS TIME DELAY COMPLETE
07- MINE DRAINED (TIMER T108)
06- TROLLEY AT MIDDLE POSITION
05- MINE ON TROLLEY LOCKOUT
04- TROLLEY IN HOME POSITION
03- DRAIN CLAMP RETRACTED
02- DRAIN CLAMP EXTENDED (CLAMPED)
01- DRAIN PUNCH RETRACTED
00- DRAIN PUNCH EXTENDED

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:11	HEX VALUE	STEP DESCRIPTION
STEP																	WORD ADRS		
0.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1000	07FF	P&D STATION PARKED AND OFF
0.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1001	07FF	PARK P&D STATION
1.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1010	07FF	INITIALIZE P&D STATION
1.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1011	07FF	WAITING FOR FEED SYSTEM
1.2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1012	07FF	LOWER APE DISCHRG STOP
1.3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1013	07FF	START CONV & SEND MINE
1.4	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1014	07FF	RAISE APE STOP & CYCLE EJECTR
2.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1020	07FF	INITIALIZE STEP
2.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1021	07FF	MINE OR CONTAINER IN YOKE
2.2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1022	07FF	TIME DELAY
2.3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1023	07FF	STOP CONVEYOR
3.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1030	07FF	INITIALIZE STEP
3.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1031	07FF	EXTEND LIFT TABLE
3.2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1032	07FF	ROTATE LIFT TABLE
3.3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1033	07FF	TIME DELAY
3.4	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1034	07FF	RETRACT LIFT TABLE
4.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1040	07FF	INITIALIZE STEP
4.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1041	07FF	RTRCT YOKE STP CLY-IF METAL MINE
4.2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1042	07FF	ROTATE YOKE TO VERTICAL
4.3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1043	07FF	EXTEND CLAMP
4.4	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1044	07FF	EXTEND PUNCH
5.0	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1050	77FF	INITIALIZE STEP
5.1	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1051	77FF	OPEN INLET VALVE 757
5.2	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1052	77FF	CLOSE VACUUM VALVE 759
5.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B11 :1053	0000	OPEN ISO VALVE + CHECK DRAIN
5.4	0	1	1	1	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1054	77FF	OPEN DRAIN VALVE 758
6.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1060	07FF	INITIALIZE STEP
6.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1061	07FF	RETRACT PUNCH
6.2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1062	07FF	RTRCT CLMP,YOKE DRV OFF,EXT STOP
7.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1070	07FF	INITIALIZE STEP
7.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1071	07FF	ROTATE YOKE TO DISCHARGE
7.2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1072	07FF	TROLLEY TAKE MINE
7.3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B11 :1073	07FF	ROTATE YOKE TO INPUT

Raytheon Engineers and Constructors - CDTF Job #9338900 September-17-02

MINE Punch & Drain File Name: PDS_APE.XLS Cntl - CTC121C C71 - Major Step Counter

Pointer Number: 15 Datatable Word (1 or 2) = **1** REV - 7 C71 - Minor Step Location

Mine Line with APE **OUTPUT** File = B11 : 1600 N100 - Display Location

17- SPARE
16- SPARE
15- SPARE
14- RETRACT DRAIN CLAMP
13- EXTEND DRAIN CLAMP (CLAMP)
12- RETRACT DRAIN PUNCH
11- EXTEND DRAIN PUNCH
10- CLOSE YOKE STOP
07- OPEN YOKE STOP
06- RUN ORIENTATION LIFT TABLE MOTOR
05- RETRACT ORIENTATION LIFT TABLE
04- EXTEND ORIENTATION LIFT TABLE
03- CYCLE EJECTOR
02- MINE MACHINE INPUT CONV FORWARD
01- APE DISCHARGE STOP UP
00- APE DISCHARGE STOP DOWN

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:18	HEX VALUE	STEP DESCRIPTION
STEP																	WORD ADRS		
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B11 :1600	0000	P&D STATION PARKED AND OFF
0.1	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1601	14A2	PARK P&D STATION
1.0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1610	14A2	INITIALIZE P&D STATION
1.1	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1611	14A2	WAITING FOR FEED SYSTEM
1.2	0	0	0	1	0	1	0	0	1	0	1	0	0	0	0	1	B11 :1612	14A1	LOWER APE DISCHRG STOP
1.3	0	0	0	1	0	1	0	0	1	0	1	0	0	1	0	1	B11 :1613	14A5	START CONV & SEND MINE
1.4	0	0	0	1	0	1	0	0	1	0	1	0	1	1	1	0	B11 :1614	14AE	RAISE APE STOP & CYCLE EJECTR
2.0	0	0	0	1	0	1	0	0	1	0	1	0	0	1	1	0	B11 :1620	14A6	INITIALIZE STEP
2.1	0	0	0	1	0	1	0	0	1	0	1	0	0	1	1	0	B11 :1621	14A6	MINE OR CONTAINER IN YOKE
2.2	0	0	0	1	0	1	0	0	1	0	1	0	0	1	1	0	B11 :1622	14A6	TIME DELAY
2.3	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1623	14A2	STOP CONVEYOR
3.0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1630	14A2	INITIALIZE STEP
3.1	0	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	B11 :1631	1492	EXTEND LIFT TABLE
3.2	0	0	0	1	0	1	0	0	1	1	0	1	0	0	1	0	B11 :1632	14D2	ROTATE LIFT TABLE
3.3	0	0	0	1	0	1	0	0	1	0	0	1	0	0	1	0	B11 :1633	1492	TIME DELAY
3.4	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1634	14A2	RETRACT LIFT TABLE
4.0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1640	14A2	INITIALIZE STEP
4.1	0	0	0	1	0	1	0	1	0	0	1	0	0	0	1	0	B11 :1641	1522	RTRCT YOKE STP CLY-IF METAL MINE
4.2	0	0	0	1	0	1	0	1	0	0	1	0	0	0	1	0	B11 :1642	1522	ROTATE YOKE TO VERTICAL
4.3	0	0	0	0	1	1	0	1	0	0	1	0	0	0	1	0	B11 :1643	0D22	EXTEND CLAMP
4.4	0	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	B11 :1644	0B22	EXTEND PUNCH
5.0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	B11 :1650	0B22	INITIALIZE STEP
5.1	0	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	B11 :1651	0B22	OPEN INLET VALVE 757
5.2	0	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	B11 :1652	0B22	CLOSE VACUUM VALVE 759
5.3	0	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	B11 :1653	0B22	OPEN ISO VALVE + CHECK DRAIN
5.4	0	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	B11 :1654	0B22	OPEN DRAIN VALVE 758
6.0	0	0	0	0	1	0	1	1	0	0	1	0	0	0	1	0	B11 :1660	0B22	INITIALIZE STEP
6.1	0	0	0	0	1	1	0	1	0	0	1	0	0	0	1	0	B11 :1661	0D22	RETRACT PUNCH
6.2	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1662	14A2	RTRCT CLMP,YOKE DRV OFF,EXT STOP
7.0	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1670	14A2	INITIALIZE STEP
7.1	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1671	14A2	ROTATE YOKE TO DISCHARGE
7.2	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1672	14A2	TROLLEY TAKE MINE
7.3	0	0	0	1	0	1	0	0	1	0	1	0	0	0	1	0	B11 :1673	14A2	ROTATE YOKE TO INPUT

Raytheon Engineers and Constructors - CDTF Job #9338900 September-17-02

MINE Punch & Drain File Name: PDS_APE.XLS Cntl - CTC121C C71 - Major Step Counter

Pointer Number: 15 Datatable Word (1 or 2) = **2** REV - 7 C71 - Minor Step Location

Mine Line with APE **OUTPUT** File = B11 : 1800 N100 - Display Location

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:19		
STEP	17- LAST SEQ STEP	16- LAST SUB STEP COMPLETE	15- REPEAT STEP PERMISSION	14- P&D SEQ BYPASS PERMISSION	13- OPEN VACUUM VALVE	12- AQS TANK LEVEL ISOLATION VALVE	11- OPEN TANK INLET VALVE	10- START PDS DELAY TIMER(T102)	07- AGENT DRAINING TO START	06- DRAIN TANK	05- CHECK FOR GOOD DRAIN	04- SPARE	03- DRAIN MINE - START TIMER	02- YOKE IS IN DISCHARGE POSITION	01- RETRACT YOKE DRIVE TO INPUT	00- EXTEND YOKE DRIVE TO DISCHARGE	WORD ADRS	HEX VALUE	STEP DESCRIPTION
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B11 :1800	0000	P&D STATION PARKED AND OFF
0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	B11 :1801	0002	PARK P&D STATION
1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	B11 :1810	0002	INITIALIZE P&D STATION
1.1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	B11 :1811	0A00	WAITING FOR FEED SYSTEM
1.2	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	B11 :1812	0A00	LOWER APE DISCHRG STOP
1.3	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	B11 :1813	0A00	START CONV & SEND MINE
1.4	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	B11 :1814	4A00	RAISE APE STOP & CYCLE EJECTR
2.0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	B11 :1820	0A00	INITIALIZE STEP
2.1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	B11 :1821	0A00	MINE OR CONTAINER IN YOKE
2.2	0	0	0	0	1	0	1	1	0	0	0	0	0	0	0	0	B11 :1822	0B00	TIME DELAY
2.3	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	B11 :1823	4A00	STOP CONVEYOR
3.0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	B11 :1830	0800	INITIALIZE STEP
3.1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	B11 :1831	0800	EXTEND LIFT TABLE
3.2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	B11 :1832	0800	ROTATE LIFT TABLE
3.3	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	B11 :1833	0900	TIME DELAY
3.4	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	B11 :1834	4800	RETRACT LIFT TABLE
4.0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	B11 :1840	0800	INITIALIZE STEP
4.1	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	B11 :1841	0800	RTRCT YOKE STP CLY-IF METAL MINE
4.2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	B11 :1842	0801	ROTATE YOKE TO VERTICAL
4.3	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	B11 :1843	0801	EXTEND CLAMP
4.4	0	1	0	0	1	0	0	0	1	0	0	0	0	0	0	0	B11 :1844	4880	EXTEND PUNCH
5.0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	B11 :1850	0880	INITIALIZE STEP
5.1	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	B11 :1851	0A08	OPEN INLET VALVE 757
5.2	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	B11 :1852	0208	CLOSE VACUUM VALVE 759
5.3	0	0	1	1	0	1	1	0	0	0	1	0	1	0	0	0	B11 :1853	3628	OPEN ISO VALVE + CHECK DRAIN
5.4	0	1	0	0	0	1	1	0	0	1	0	0	1	0	0	0	B11 :1854	4648	OPEN DRAIN VALVE 758
6.0	0	0	0	0	1	0	1	0	0	0	0	0	1	0	0	0	B11 :1860	0A08	INITIALIZE STEP
6.1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	B11 :1861	0A00	RETRACT PUNCH
6.2	0	1	0	0	1	0	1	0	0	0	0	0	0	0	0	0	B11 :1862	4A00	RTRCT CLMP,YOKE DRV OFF,EXT STOP
7.0	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	0	B11 :1870	0A00	INITIALIZE STEP
7.1	0	0	0	0	1	0	1	0	0	0	0	0	0	0	0	1	B11 :1871	0A01	ROTATE YOKE TO DISCHARGE
7.2	0	0	0	0	1	0	1	0	0	0	0	0	0	1	0	1	B11 :1872	0A05	TROLLEY TAKE MINE
7.3	1	0	0	0	1	0	1	0	0	0	0	0	0	0	1	0	B11 :1873	8A02	ROTATE YOKE TO INPUT

Washington International - CDTF Job #9338900 September-17-02

MINE Burster Punch File Name: BPSFARS.XLS Cntl - CTC121C C81 - Major Step Counter

Pointer Number: 21 Datatable Word (1 or 2) = **1** REV - 6B C81 - Minor Step Location

Mine Line with FARS **INPUT COMPARISON** File = B12 : 0 N200 - Display Location

17- SPARE
16- SPARE
15- SPARE
14- SPARE
13- TIME DELAY FOR MOTOR RUN
12- BPS TIME DELAY COMPLETE
11- MINE AT PUSH OUT
10- BLAST GATE CLOSED (SIMULATED)
07- SPANNER PLATE RETRACTED
06- SPANNER PLATE EXTENDED
05- MINE ON TROLLEY LOCKOUT
04- TROLLEY AT MIDDLE POSITION
03- MINE AT BURSTER PUNCH STATION
02- TROLLEY IN EXTENDED POSITION
01- TROLLEY IN RETRACTED POSITION (HOME)
00- YOKE IN DISCHARGE POSITION

BITS / STEP	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:20 WORD ADRS	HEX VALUE	STEP DESCRIPTION
0.0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	B12 :0	0082	BP STATION PARKED & OFF
0.1	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	B12 :1	0082	PARK BP STATION
1.0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	B12 :10	0082	INITIALIZE BP STATION
1.1	0	0	0	0	0	0	0	0	1	0	1	0	0	0	1	1	B12 :11	00A3	WAITING FOR YOKE WITH MINE
1.2	0	0	0	0	0	1	0	0	1	0	1	0	0	0	1	1	B12 :12	04A3	TIME DELAY
1.3	0	0	0	0	0	0	0	0	1	0	0	0	1	1	0	0	B12 :13	008C	EXTEND TROLLEY TO BP STATION
1.4	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	B12 :14	048C	TIME DELAY
2.0	0	0	0	0	0	1	0	0	1	0	0	0	1	1	0	0	B12 :20	048C	STEP INITIALIZE
2.1	0	0	0	0	0	0	0	1	0	1	0	0	0	1	0	0	B12 :21	0144	EXTEND SPANNER PLATE
2.2	0	0	0	0	0	0	0	1	0	1	0	1	0	0	0	0	B12 :22	0150	START MOTOR
2.3	0	0	0	0	0	1	0	1	0	1	0	1	0	0	0	0	B12 :23	0550	TIME DELAY TO UNSCREW
3.0	0	0	0	0	0	1	0	0	0	1	0	1	0	0	0	0	B12 :30	0450	STEP INITIALIZE
3.1	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	B12 :31	0090	RETRACT TROLLEY TO MID POSITION
3.2	0	0	0	0	0	0	0	0	1	0	0	1	0	0	0	0	B12 :32	0090	RETRACT SPANNER PLATE
3.3	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	B12 :33	0084	EXTEND TROLLEY FOR MINE PUSHOFF
3.4	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1	0	B12 :34	0082	RETRACT TROLLEY TO HOME POSITION

Washington International - CDTF Job #9338900 September-17-02

MINE Burster Punch File Name: BPSFARS.XLS Cntl - CTC121C C81 - Major Step Counter

Pointer Number: 21 Datatable Word (1 or 2) = **2** REV - 6B C81 - Minor Step Location

Mine Line with FARS **INPUT COMPARISON** File = B12 : 200 N200 - Display Location

17- SPARE
16- SPARE
15- SPARE
14- SPARE
13- SPARE
12- SPARE
11- SPARE
10- SPARE
07- SPARE
06- SPARE
05- SPARE
04- SPARE
03- SPARE
02- SPARE
01- SPARE
00- SPARE

BITS / STEP	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:21 WORD ADRS	HEX VALUE	STEP DESCRIPTION
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :200	0000	BP STATION PARKED & OFF
0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :201	0000	PARK BP STATION
1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :210	0000	INITIALIZE BP STATION
1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :211	0000	WAITING FOR YOKE WITH MINE
1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :212	0000	TIME DELAY
1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :213	0000	EXTEND TROLLEY TO BP STATION
1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :214	0000	TIME DELAY
2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :220	0000	STEP INITIALIZE
2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :221	0000	EXTEND SPANNER PLATE
2.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :222	0000	START MOTOR
2.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :223	0000	TIME DELAY TO UNSCREW
3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :230	0000	STEP INITIALIZE
3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :231	0000	RETRACT TROLLEY TO MID POSITION
3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :232	0000	RETRACT SPANNER PLATE
3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :233	0000	EXTEND TROLLEY FOR MINE PUSHOFF
3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :234	0000	RETRACT TROLLEY TO HOME POSITION

Washington International - CDTF Job #9338900 September-17-02

MINE Burster Punch File Name: BPSFARS.XLS Cntl - CTC121C C81 - Major Step Counter

Pointer Number: 22 Datatable Word (1 or 2) = **1** REV - 6B C81 - Minor Step Location

Mine Line with FARS **NORMAL MASK** File = B12 : 400 N200 - Display Location

17- SPARE
16- SPARE
15- SPARE
14- SPARE
13- TIME DELAY FOR MOTOR RUN
12- BPS TIME DELAY COMPLETE
11- MINE AT PUSH OUT
10- BLAST GATE CLOSED (SIMULATED)
07- SPANNER PLATE RETRACTED
06- SPANNER PLATE EXTENDED
05- MINE ON TROLLEY LOCKOUT
04- TROLLEY AT MIDDLE POSITION
03- MINE AT BURSTER PUNCH STATION
02- TROLLEY IN EXTENDED POSITION
01- TROLLEY IN RETRACTED POSITION (HOME)
00- YOKE IN DISCHARGE POSITION

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:20		
STEP																	WORD ADRS	**HEX VALUE**	**STEP DESCRIPTION**
0.0	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	B12 :400	06FF	BP STATION PARKED & OFF
0.1	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	B12 :401	06FF	PARK BP STATION
1.0	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	B12 :410	06FF	INITIALIZE BP STATION
1.1	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	B12 :411	06FF	WAITING FOR YOKE WITH MINE
1.2	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	1	B12 :412	06FF	TIME DELAY
1.3	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	B12 :413	04FF	EXTEND TROLLEY TO BP STATION
1.4	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	B12 :414	04FF	TIME DELAY
2.0	0	0	0	0	0	1	0	0	1	1	1	1	1	1	1	1	B12 :420	04FF	STEP INITIALIZE
2.1	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	1	B12 :421	05F7	EXTEND SPANNER PLATE
2.2	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	1	B12 :422	05F7	START MOTOR
2.3	0	0	0	0	0	1	0	1	1	1	1	1	0	1	1	1	B12 :423	05F7	TIME DELAY TO UNSCREW
3.0	0	0	0	0	0	1	0	0	1	1	1	1	0	1	1	1	B12 :430	04F7	STEP INITIALIZE
3.1	0	0	0	0	0	1	0	0	1	1	1	1	0	1	1	1	B12 :431	04F7	RETRACT TROLLEY TO MID POSITION
3.2	0	0	0	0	0	1	0	0	1	1	1	1	0	1	1	1	B12 :432	04F7	RETRACT SPANNER PLATE
3.3	0	0	0	0	0	1	0	0	1	1	1	1	0	1	1	1	B12 :433	04F7	EXTEND TROLLEY FOR MINE PUSHOFF
3.4	0	0	0	0	0	1	1	0	1	1	1	1	1	1	1	0	B12 :434	06FE	RETRACT TROLLEY TO HOME POSITION

Washington International - CDTF Job #9338900 September-17-02

MINE Burster Punch File Name: BPSFARS.XLS Cntl - CTC121C C81 - Major Step Counter

Pointer Number: 22 Datatable Word (1 or 2) = **2** REV - 6B C81 - Minor Step Location

Mine Line with FARS **NORMAL MASK** File = B12 : 600 N200 - Display Location

17- SPARE
16- SPARE
15- SPARE
14- SPARE
13- SPARE
12- SPARE
11- SPARE
10- SPARE
07- SPARE
06- SPARE
05- SPARE
04- SPARE
03- SPARE
02- SPARE
01- SPARE
00- SPARE

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:21		
STEP																	WORD ADRS	**HEX VALUE**	**STEP DESCRIPTION**
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :600	0000	BP STATION PARKED & OFF
0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :601	0000	PARK BP STATION
1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :610	0000	INITIALIZE BP STATION
1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :611	0000	WAITING FOR YOKE WITH MINE
1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :612	0000	TIME DELAY
1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :613	0000	EXTEND TROLLEY TO BP STATION
1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :614	0000	TIME DELAY
2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :620	0000	STEP INITIALIZE
2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :621	0000	EXTEND SPANNER PLATE
2.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :622	0000	START MOTOR
2.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :623	0000	TIME DELAY TO UNSCREW
3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :630	0000	STEP INITIALIZE
3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :631	0000	RETRACT TROLLEY TO MID POSITION
3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :632	0000	RETRACT SPANNER PLATE
3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :633	0000	EXTEND TROLLEY FOR MINE PUSHOFF
3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :634	0000	RETRACT TROLLEY TO HOME POSITION

Washington International - CDTF Job #9338900 September-17-02

MINE Burster Punch File Name: BPSFARS.XLS Cntl - CTC121C C81 - Major Step Counter

Pointer Number: 23 Datatable Word (1 or 2) = **1** REV - 6B C81 - Minor Step Location

Mine Line with FARS **BYPASS MASK** File = B12 : 800 N200 - Display Location

17- SPARE
16- SPARE
15- SPARE
14- SPARE
13- TIME DELAY FOR MOTOR RUN
12- BPS TIME DELAY COMPLETE
11- MINE AT PUSH OUT
10- BLAST GATE CLOSED (SIMULATED)
07- SPANNER PLATE RETRACTED
06- SPANNER PLATE EXTENDED
05- MINE ON TROLLEY LOCKOUT
04- TROLLEY AT MIDDLE POSITION
03- MINE AT BURSTER PUNCH STATION
02- TROLLEY IN EXTENDED POSITION
01- TROLLEY IN RETRACTED POSITION (HOME)
00- YOKE IN DISCHARGE POSITION

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:20		
STEP																	WORD ADRS	**HEX VALUE**	**STEP DESCRIPTION**
0.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :800	07FF	BP STATION PARKED & OFF
0.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :801	07FF	PARK BP STATION
1.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :810	07FF	INITIALIZE BP STATION
1.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :811	07FF	WAITING FOR YOKE WITH MINE
1.2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :812	07FF	TIME DELAY
1.3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :813	07FF	EXTEND TROLLEY TO BP STATION
1.4	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :814	07FF	TIME DELAY
2.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :820	07FF	STEP INITIALIZE
2.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :821	07FF	EXTEND SPANNER PLATE
2.2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :822	07FF	START MOTOR
2.3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :823	07FF	TIME DELAY TO UNSCREW
3.0	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :830	07FF	STEP INITIALIZE
3.1	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :831	07FF	RETRACT TROLLEY TO MID POSITION
3.2	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :832	07FF	RETRACT SPANNER PLATE
3.3	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :833	07FF	EXTEND TROLLEY FOR MINE PUSHOFF
3.4	0	0	0	0	0	1	1	1	1	1	1	1	1	1	1	1	B12 :834	07FF	RETRACT TROLLEY TO HOME POSITION

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MINE Burster Punch File Name: BPSFARS.XLS Cntl - CTC121C C81 - Major Step Counter

Pointer Number: 23 Datatable Word (1 or 2) = **2** REV - 6B C81 - Minor Step Location

Mine Line with FARS **BYPASS MASK** File = B12 : 1000 N200 - Display Location

17- SPARE
16- SPARE
15- SPARE
14- SPARE
13- SPARE
12- SPARE
11- SPARE
10- SPARE
07- SPARE
06- SPARE
05- SPARE
04- SPARE
03- SPARE
02- SPARE
01- SPARE
00- SPARE

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:21		
STEP																	WORD ADRS	**HEX VALUE**	**STEP DESCRIPTION**
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1000	0000	BP STATION PARKED & OFF
0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1001	0000	PARK BP STATION
1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1010	0000	INITIALIZE BP STATION
1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1011	0000	WAITING FOR YOKE WITH MINE
1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1012	0000	TIME DELAY
1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1013	0000	EXTEND TROLLEY TO BP STATION
1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1014	0000	TIME DELAY
2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1020	0000	STEP INITIALIZE
2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1021	0000	EXTEND SPANNER PLATE
2.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1022	0000	START MOTOR
2.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1023	0000	TIME DELAY TO UNSCREW
3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1030	0000	STEP INITIALIZE
3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1031	0000	RETRACT TROLLEY TO MID POSITION
3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1032	0000	RETRACT SPANNER PLATE
3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1033	0000	EXTEND TROLLEY FOR MINE PUSHOFF
3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1034	0000	RETRACT TROLLEY TO HOME POSITION

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MINE Burster Punch File Name: BPSFARS.XLS Cntl - CTC121C C81 - Major Step Counter

Pointer Number: 25 Datatable Word (1 or 2) = **1** REV - 6B C81 - Minor Step Location

Mine Line with FARS **OUTPUT** File = B12 : 1600 N200 - Display Location

17- LAST SEQ STEP
16- LAST SUBSTEP COMPLETE
15- REPEAT STEP PERMISSION
14- BYPASS PERMISSION
13- SPARE
12- START BPS DELAY TIMER
11- SPARE
10- SPARE
07- SPARE
06- START TIMER FOR MOTOR RUN
05- TROLLEY RETRACTED (HOME)
04- START MOTOR
03- RETRACT SPANNER PLATE
02- EXTEND SPANNER PLATE
01- RETRACT MINE TROLLEY (HOME)
00- EXTEND MINE TROLLEY

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:28		
STEP																	WORD ADRS	HEX VALUE	STEP DESCRIPTION
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1600	0000	BP STATION PARKED & OFF
0.1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	B12 :1601	002A	PARK BP STATION
1.0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	B12 :1610	000A	INITIALIZE BP STATION
1.1	0	0	0	0	0	0	0	0	0	0	1	0	1	0	1	0	B12 :1611	002A	WAITING FOR YOKE WITH MINE
1.2	0	0	0	0	0	1	0	0	0	0	1	0	1	0	1	0	B12 :1612	042A	TIME DELAY
1.3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	B12 :1613	0009	EXTEND TROLLEY TO BP STATION
1.4	0	1	0	0	0	1	0	0	0	0	0	0	1	0	0	1	B12 :1614	4409	TIME DELAY
2.0	0	0	0	0	0	1	0	0	0	0	0	0	1	0	0	1	B12 :1620	0409	STEP INITIALIZE
2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	1	B12 :1621	0005	EXTEND SPANNER PLATE
2.2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	0	B12 :1622	0006	START MOTOR
2.3	0	1	0	0	0	1	0	0	0	0	0	0	0	1	0	0	B12 :1623	4404	TIME DELAY TO UNSCREW
3.0	0	0	0	0	0	1	0	0	0	0	0	0	0	1	0	0	B12 :1630	0404	STEP INITIALIZE
3.1	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	B12 :1631	0008	RETRACT TROLLEY TO MID POSITION
3.2	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	B12 :1632	0008	RETRACT SPANNER PLATE
3.3	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	1	B12 :1633	0009	EXTEND TROLLEY FOR MINE PUSHOFF
3.4	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	B12 :1634	800A	RETRACT TROLLEY TO HOME POSITION

Washington International - CDTF Job #9338900 September-17-02

MINE Burster Punch File Name: BPSFARS.XLS Cntl - CTC121C C81 - Major Step Counter

Pointer Number: 25 Datatable Word (1 or 2) = **2** REV - 6B C81 - Minor Step Location

Mine Line with FARS **OUTPUT** File = B12 : 1800 N200 - Display Location

17- SPARE
16- SPARE
15- SPARE
14- SPARE
13- SPARE
12- SPARE
11- SPARE
10- SPARE
07- SPARE
06- SPARE
05- SPARE
04- SPARE
03- SPARE
02- SPARE
01- SPARE
00- SPARE

BITS	17	16	15	14	13	12	11	10	07	06	05	04	03	02	01	00	B10:29 WORD ADRS	HEX VALUE	STEP DESCRIPTION
STEP																			
0.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1800	0000	BP STATION PARKED & OFF
0.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1801	0000	PARK BP STATION
1.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1810	0000	INITIALIZE BP STATION
1.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1811	0000	WAITING FOR YOKE WITH MINE
1.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1812	0000	TIME DELAY
1.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1813	0000	EXTEND TROLLEY TO BP STATION
1.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1814	0000	TIME DELAY
2.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1820	0000	STEP INITIALIZE
2.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1821	0000	EXTEND SPANNER PLATE
2.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1822	0000	START MOTOR
2.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1823	0000	TIME DELAY TO UNSCREW
3.0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1830	0000	STEP INITIALIZE
3.1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1831	0000	RETRACT TROLLEY TO MID POSITION
3.2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1832	0000	RETRACT SPANNER PLATE
3.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1833	0000	EXTEND TROLLEY FOR MINE PUSHOFF
3.4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	B12 :1834	0000	RETRACT TROLLEY TO HOME POSITION

APPENDIX E
Operator Screens

Appendix E contains Advisor PC screens associated with the operation and control of the MHS. Table E.1 provides an index to the MHS Advisor PC screens.

Table E.1 MHS Advisor PC Screens

Figure #	Advisor PC Screen Name	Process Screen
E-1	Mine Handling System	MHS
E-2	Mine Demil Line – ECR A	MIN
E-3	Mine Initialize	MNI

The MHS and MIN screens were generated based on the CDTF control code as of April 3, 2002 and the MNI screen was generated based on the TOCDF control code as of October 13, 1997. CDTF process screens are shown because they more closely reflect the configuration that will be used at TOCDF. Because the CDTF screens are under development and the TOCDF screen reflects the old mine processing configuration, some of the displays will change when implemented for the TOCDF mine campaign. Anticipated changes for each screen are listed in Table E.2. When Advisor PC screens are generated for ANCDF, PBCDF, and UMCDF, they will be included in this appendix.

Table E.2 TOCDF MHS Advisor PC Screen Anticipated Changes

Process Screen	Advisor PC Screen Name	TOCDF Anticipated Changes
MHS	Mine Handling System	1. Modify to reflect line B tag numbers (e.g., MMS-CNVM-104). 2. Modify to include TOCDF tag numbers rather than CDTF tags. 3. At CDTF, MMS-CNVM-103 extends from UPA, through the airlock, and through ECV. At TOCDF, the conveyor in the UPA and airlock will be a separate conveyor. Modify to show new conveyor.
MIN	Mine Demil Line - ECR A	1. Modify to reflect use of ECR B. 2. Modify to include TOCDF tag numbers rather than CDTF tags (e.g., AQS tag numbers). 3. Remove APE devices and replace with MCC verification station. 4. Change BPS sequencer to FARS sequencer.
MNI	Mine Initialize	Modify to reflect FARS initialize rather than BPS.

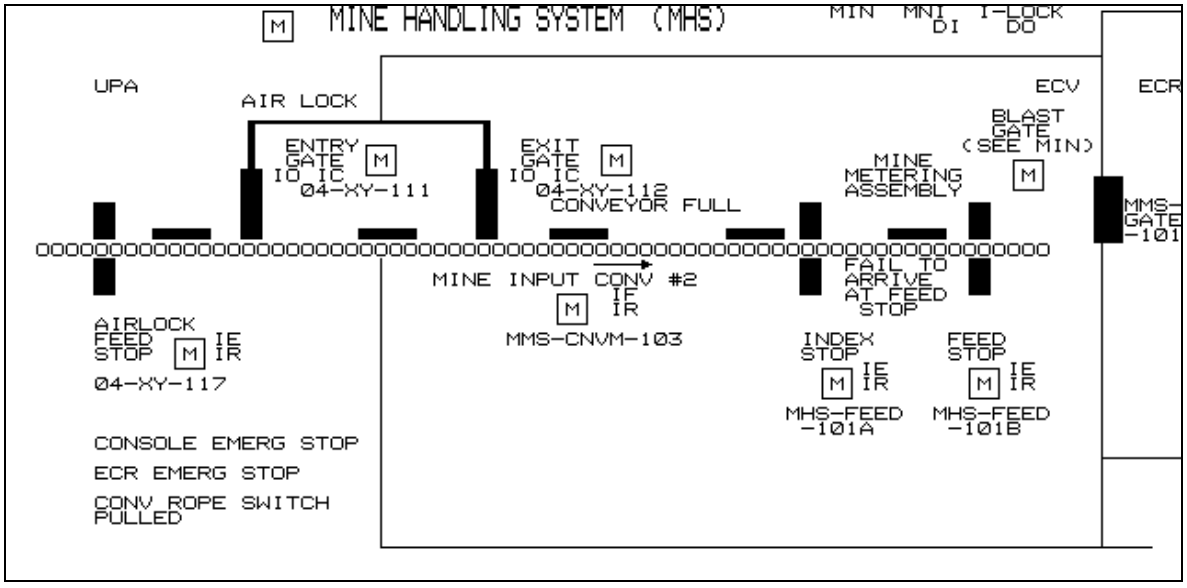

Figure E-1. CDTF Advisor PC Screen Mine Handling System (MHS)

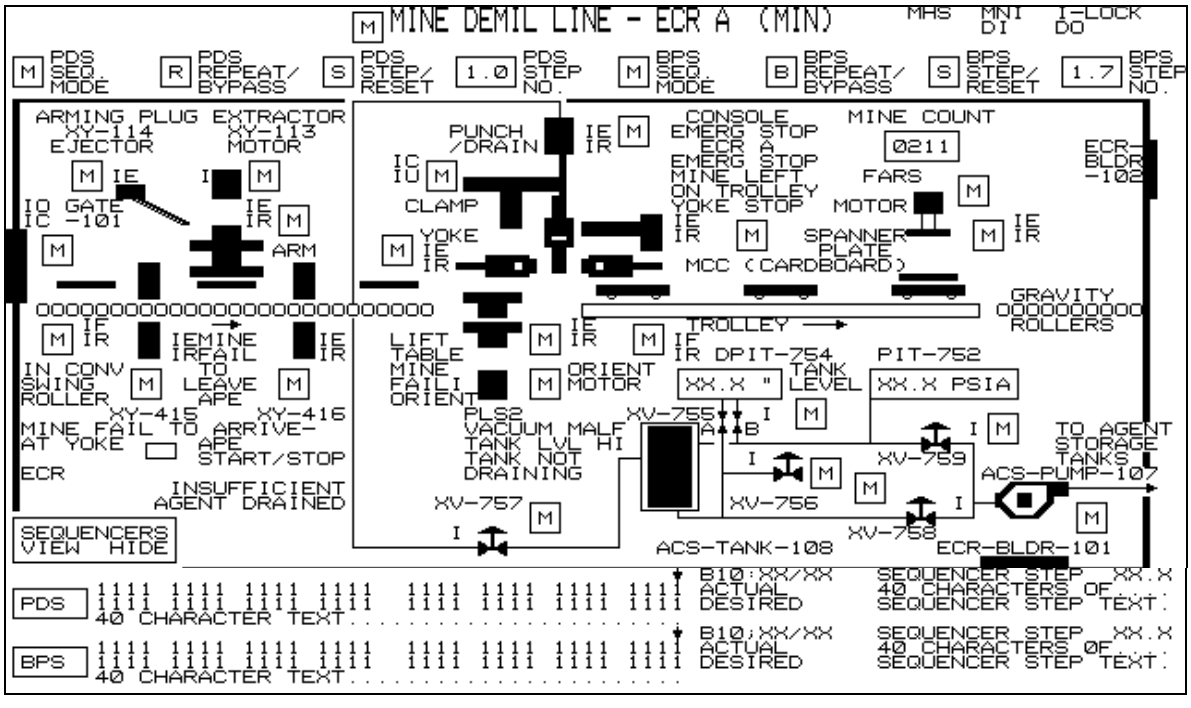

Figure E-2. CDTF Advisor PC Screen Mine Demil Line - ECR A (MIN)

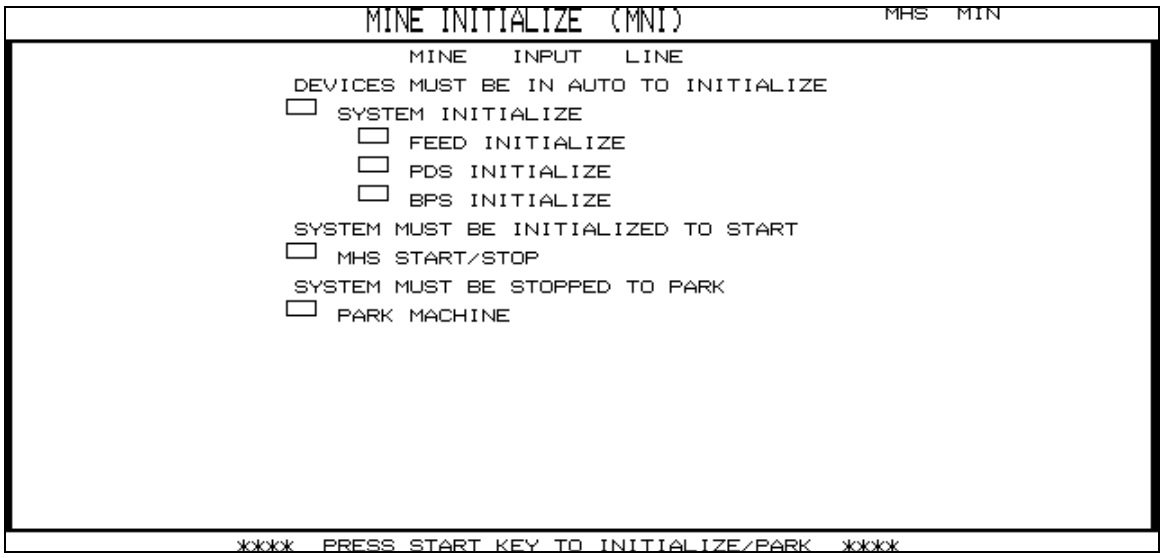

Figure E-3. TOCDF Advisor PC Screen Mine Initialize (MNI)

APPENDIX F

Instrument Ranges

Table F.1 shows the instrument data extracted from the TOCDF Loveland calibration database for MHS instrumentation as of August 2000.

Table F.1 MHS Instrumentation in TOCDF Loveland Instrument Calibration Database

INSTRUMENT TAG	RCRA	INPUT		OUTPUT		SET POINT	LOOP DEFINITION
		RANGE	UNIT	RANGE	UNIT		
03-XSH-127A	No	0.0 –1.0	psig			0.5	ECR A EXPLOSION
03-XSH-127B	No	0.0 –1.0	psig			0.5	ECR A EXPLOSION
03-XSH-227A	No	0.0 –1.0	psig			0.5	ECR B EXPLOSION
03-XSH-227B	No	0.0 –1.0	psig			0.5	ECR B EXPLOSION

APPENDIX G

Intercontroller Communications

At TOCDF, control for the MHS will be provided by ICS-CONR-104C because TOCDF will be processing mines in ECR B. ICS-CONR-104C is the same controller as ICS-CONR-104A (used for rocket line B), configured for mine processing. The original design specified use of ECR A for mine processing with control by ICS-CONR-101C, which is the same controller as ICS-CONR-101A (used for rocket line A), configured for mine processing. The designs for ANCDF, PBCDF, and UMCDF specify use of ECR A for mine processing with control by ICS-CONR-101C, similar to the original TOCDF design.

The TOCDF code as of October 13, 1997 did not include any DICOs for ICS-CONR-101C that were different than those for ICS-CONR-101A; DICOs for CONR-101A are listed in the rocket handling system FAWB, programmatic process FAWB Book 21. Because ICS-CONR-104C code is still being developed, no DICOs unique to mine processing have been developed. When DICOs are generated for mine processing, they will be included in this appendix.

APPENDIX H

References

PROGRAMMATIC

CSDP Control Systems Software Design Guide, Revision 19, 12 March 93.

JACADS VX M23 Mine Campaign Report, 23 Jan 01.

JACADS Control System Source Code, November 2000.

JACADS Standing Operating Procedure for UPA Operations for M23, VX Mines, JI-0000-M-113, Rev.0, Change 5, 10 October 2000.

JACADS Standing Operating Procedure for M23 Mine Machine Operation, JI-0000-M-118, Rev.0, 05 September 2000.

Memorandum, SFAE-CD-CO-O, 8 Jan 01, Subject: Mine Machine Modification for CONUS Sites Meeting, 30 and 31 Jan 01.

Department of the Army Pamphlet 385-61, Toxic Chemical Agent Safety Standards, 27 March 2002

ANCDF (through ECP ANAP1258ICS, March 2002)

AN-1-D-501, Rev.7, 6-22-01	Rocket Processing System (A), P&ID
AN-1-D-503, Rev.7, 6-22-01	Mine Processing System, P&ID
AN-1-D-507, Rev.4, 10-2-98	Tray/Dunnage Processing System (A), P&ID
AN-1-D-508, Rev.4, 10-2-98	Tray Processing System (B), P&ID
AN-1-D-540, Rev.0, 1-2-96	Mine Glove Box, P&ID
AN-1-D-555, Rev.2, 6-22-01	Mine Machine, P&ID
AN-1-E-74/1, Rev.11, 12-14-01	Electrical, Panel Schedules
AN-1-E-74/2, Rev.7, 12-14-01	Electrical, Panel Schedules
AN-1-E-907, Rev.0, 1-2-96	SPS-MCC-103 480V MCC-Conveyor No. 1, Single Line Diagram

PBCDF (through change case PB-07-98-0219R1, March 2002)

PB-1-D-501, Rev.5, 1-11-02	Rocket Processing System (A), P&ID
PB-1-D-503, Rev.4, 1-11-02	Mine Processing System, P&ID
PB-1-D-507, Rev.4, 5-10-01	Dunnage Processing System, P&ID
PB-1-D-509, Rev.3, 5-10-01	Leakers Processing System, P&ID

PBCDF (cont'd)

PB-1-D-512, Rev.2, 5-10-01	Charge Car (2nd Floor), P&ID
PB-1-D-514, Rev.7, 5-10-01	Bulk Processing Line, P&ID
PB-1-D-515, Rev.6, 6-29-01	Bulk Drain System, P&ID PB-1-D-519, Rev.6, 1-11-02 UPA Lift Car, P&ID
PB-1-D-520, Rev.1, 7-10-98	UPA Conveyors, P&ID
PB-1-D-540, Rev.1, 5-10-01	Mine Glove Box, P&ID
PB-1-D-555, Rev.2, 1-24-01	Mine Machine, P&ID
PB-1-E-909, Rev.0, 6-2-97	SPS-MCC-104 480V MCC-Conveyor No. 2, Single Line Diagram

TOCDF

TOCDF Functional Analysis Workbook, Section III, Chapter 5.3, Mine Handling Systems, Rev. 0, 23 April 93.

TOCDF Control System Source Code, February 2002.

TOCDF Loveland Instrument Calibration Database, August 2000.

TE-1-D-502, Rev.23, 3-14-01	Rocket Processing System (B), P&ID
TE-1-D-503, Rev.14, 5-20-99	Mine Processing System, P&ID
TE-1-D-507, Rev.12, 1-30-96	Tray/Dunnage Processing System (A), P&ID
TE-1-D-508, Rev.13, 1-30-96	Tray Processing System (B), P&ID
TE-1-D-512, Rev.12, 4-14-98	Buffer Storage/Charge Car (2nd Floor) - Charge Car (2nd Floor)
TE-1-D-540, Rev.10, 8-31-94	Mine Glove Box, P&ID
TE-1-D-555, Rev.11, 3-20-97	Mine Machine, P&ID
TE-1-E-74/1, Rev.42, 04-2-02	Electrical, Panel Schedules
TE-1-E-907, Rev.13, 10-24-01	SPS-MCC-103 480V MCC-Conveyor No. 1, Single Line Diagram
TE-1-E-908, Rev.15, 10-24-01	SPS-MCC-103 480V MCC-Conveyor No. 1, Single Line Diagram

UMCDF (through CP-1024 & CP-1050, April 2002)

UM-1-D-501, Rev.6, 7-20-01	Rocket Processing System (A), P&ID
UM-1-D-503, Rev.4, 7-10-00	Mine Processing System, P&ID
UM-1-D-507, Rev.4, 9-13-00	Tray/Dunnage Processing System (A), P&ID
UM-1-D-508, Rev.4, 9-13-00	Tray Processing System (B), P&ID
UM-1-D-540, Rev.1, 9-13-00	Mine Glove Box, P&ID
UM-1-D-555, Rev.2, 7-10-00	Mine Machine, P&ID
UM-1-E-74/1, Rev.8, 4-20-01	Electrical, Panel Schedules
UM-1-E-907, Rev.1, 2-1-00	SPS-MCC-103 480V MCC-Conveyor No. 1, Single Line Diagram